Compress

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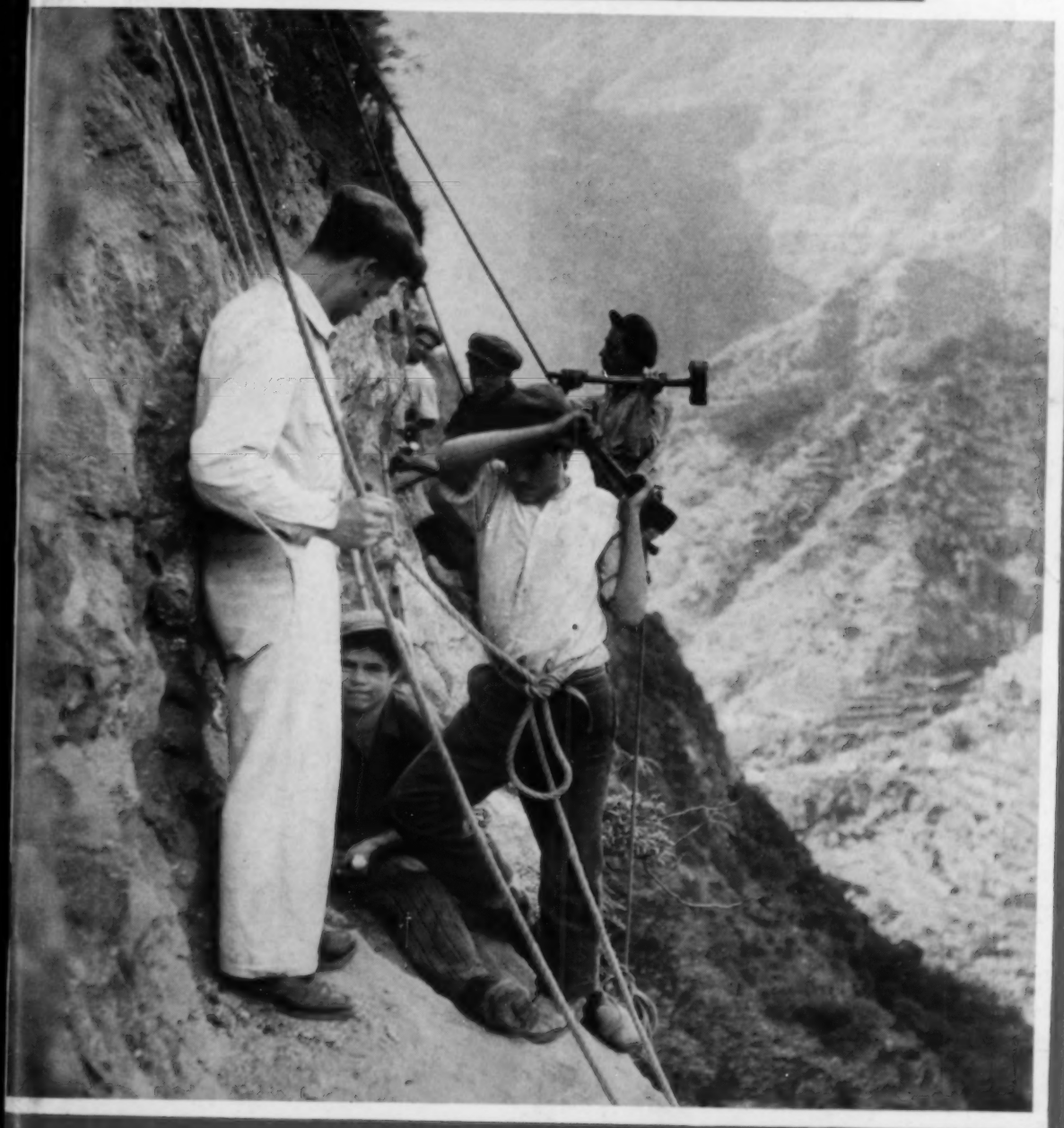


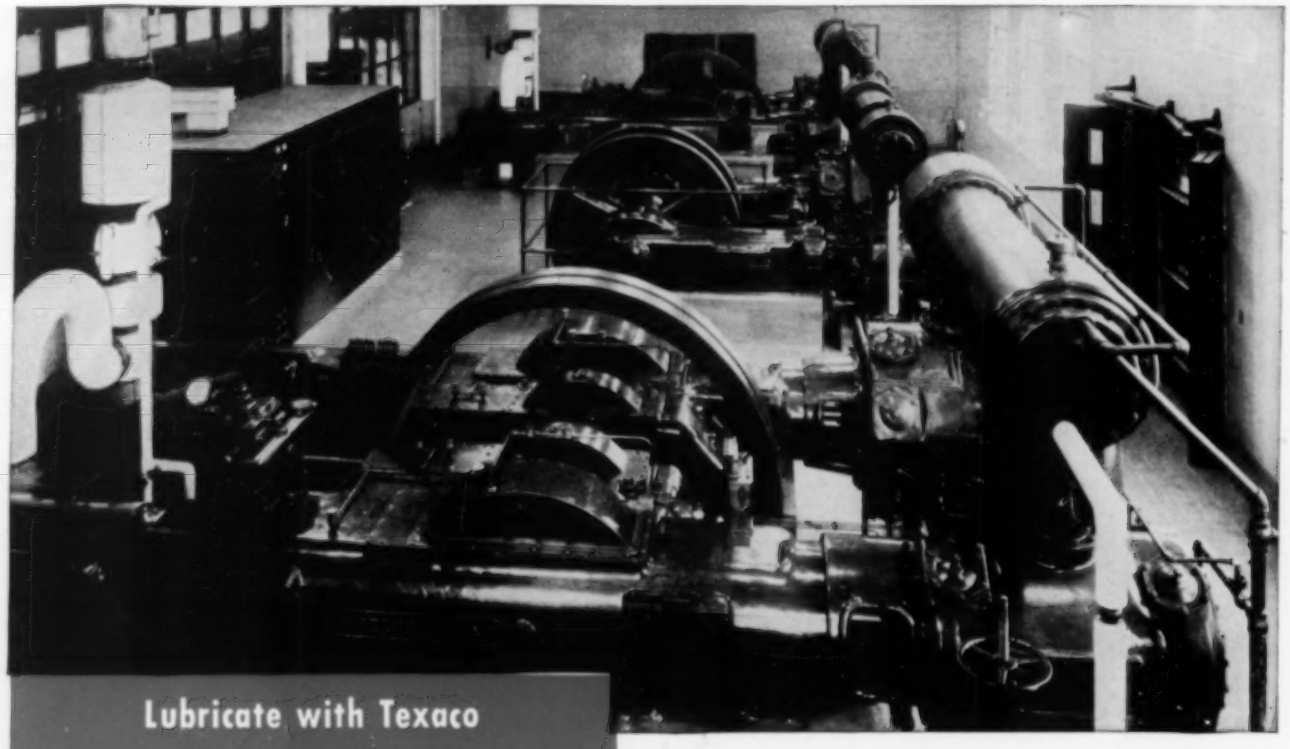
HAND DRILLING ON ISLAND OF MADEIRA

Slow manual method used on high cliffs inaccessible to air compressors

VOLUME 54 • NUMBER 8

NEW YORK • LONDON

PROTECT your compressors against Rust, Water and Wear



Lubricate with Texaco air compressor oils... a complete line to meet all conditions

NO ONE OIL can meet all the varying conditions of air compressor service. But Texaco has a complete line of air compressor oils to assure clean valves, free rings, open ports, clear air lines, whatever the type or size of your compressors . . . whatever your operating conditions.

Texaco offers straight mineral oils for regular service . . . compounded oils for use where water is present . . . oils designed to prevent rust . . . heavy duty oils for unusually severe service, or where carbon and gum are causing trouble — all highly effective in prolonging compressor life, increasing efficiency and reducing costs.

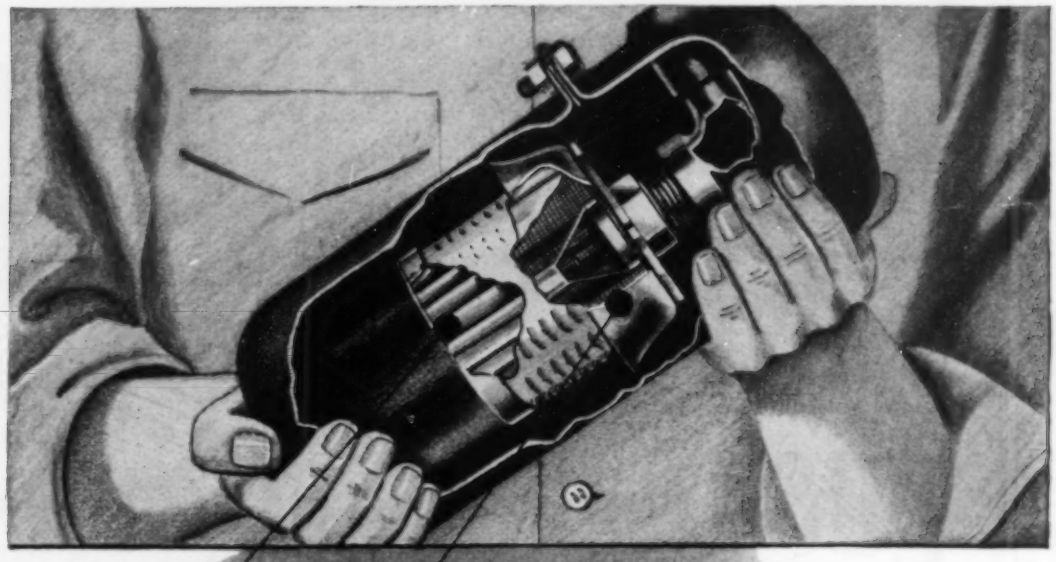
A Texaco Lubrication Engineer will gladly help you select the oils you need for best results. Just call the nearest of the more than 2300 Texaco Wholesale Distributing Plants in the 48 States, or write The Texas Company, 135 East 42nd Street, New York 17, N. Y.

TEXACO

TEXACO Air Compressor Oils

FOR ALL OPERATING CONDITIONS

STAYNEW PIPE LINE FILTERS



ELIMINATE

MOISTURE
OIL
DIRT
PIPE SCALE

from Compressed Air Lines

Tests prove that Staynew Filters often save their entire cost in just a few weeks. By preventing the passage of foreign matter, including moisture (water and oil), they prevent excess wear, costly freeze-ups, damage to materials and interference with processes.

EXCLUSIVE DOUBLE-ACTION PRINCIPLE PROVIDES:

MECHANICAL SEPARATION—Deflector Cup drives foreign matter to bottom of container where heavier particles are deposited.

FILTRATION—air or gas rises thru the original Radial Fin Insert which removes the lighter material.

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THE HANDY HOIST OF A HUNDRED USES

a new midget hoist FOR MAINTENANCE MEN

The new Ingersoll-Rand BU Hoist was designed for the many hoisting, skidding and hauling jobs the maintenance man encounters every day. Maintenance crews in all industrial plants find it a great time saver for moving machinery, snaking water, steam, and air lines into position, pulling power cables through conduits, hoisting equipment and materials for overhead work, moving structural steel members, handling parts for repair of cranes and other heavy machines, installing pipe and backfilling on trenching jobs, etc.

AIR POWER — The Key to Lower Maintenance Costs

Loads can be lowered under power for maximum safety or on brake for maximum speed. The wide band-type brake holds the load, and the convenient clutch lever located at the gear end of the hoist permits the drum to be readily disengaged for quickly pulling out cable. A sturdy four-cylinder piston-type, reversible, radial air motor with safety-type throttle provides plenty of power to lift loads of 600 pounds at 50 feet per minute.

Only 18½ inches long by 10¾ inches wide and 11¼ inches high, the BU is a compact, lightweight (72 pounds less rope) hoist that may easily be carried and installed by one man alone.

Call your Ingersoll-Rand branch for complete information on the BU Hoist and other Air Tools which now pay for themselves in nearly half the time formerly required, and enable the workman to do more work with less effort.

Ingersoll-Rand

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If yours is a problem of cost-cutting . . . of increasing present production or of entering an entirely new field . . . it will pay you to review the products and services at left. Wherever you are, a representative will be glad to contact you.

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PITTSBURGH, PENNSYLVANIA, U. S. A.

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Help yourself to better piping

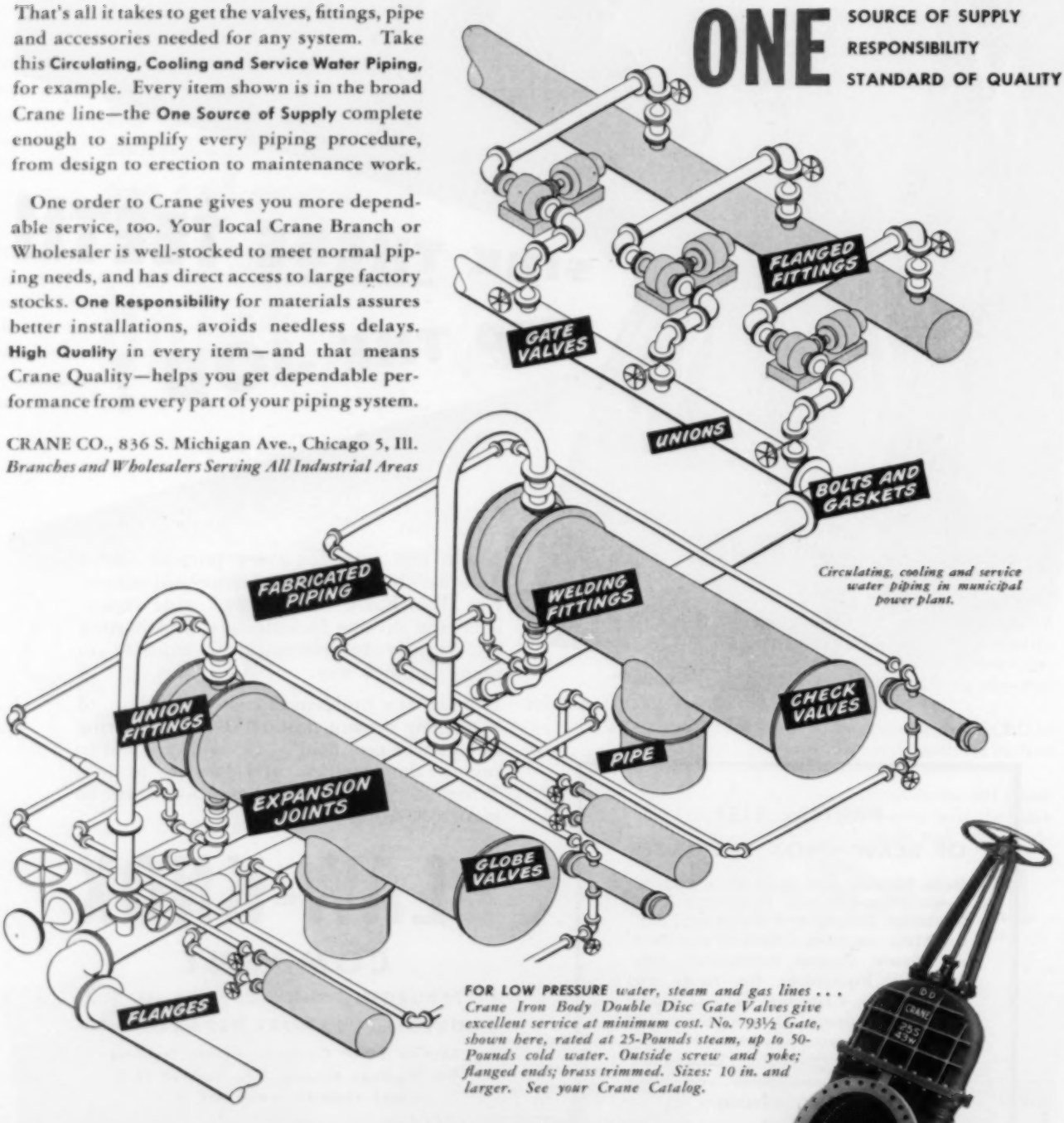
. . . with <u>one order</u> to CRANE

That's all it takes to get the valves, fittings, pipe and accessories needed for any system. Take this **Circulating, Cooling and Service Water Piping,** for example. Every item shown is in the broad Crane line—the **One Source of Supply** complete enough to simplify every piping procedure, from design to erection to maintenance work.

One order to Crane gives you more dependable service, too. Your local Crane Branch or Wholesaler is well-stocked to meet normal piping needs, and has direct access to large factory stocks. **One Responsibility** for materials assures better installations, avoids needless delays. **High Quality** in every item—and that means Crane Quality—helps you get dependable performance from every part of your piping system.

CRANE CO., 836 S. Michigan Ave., Chicago 5, Ill.
Branches and Wholesalers Serving All Industrial Areas

ONE SOURCE OF SUPPLY
RESPONSIBILITY
STANDARD OF QUALITY



Circulating, cooling and service water piping in municipal power plant.

FOR LOW PRESSURE *water, steam and gas lines . . . Crane Iron Body Double Disc Gate Valves give excellent service at minimum cost. No. 793½ Gate, shown here, rated at 25-Pounds steam, up to 50-Pounds cold water. Outside screw and yoke; flanged ends; brass trimmed. Sizes: 10 in. and larger. See your Crane Catalog.*

EVERYTHING FROM . . .

VALVES • FITTINGS
PIPE • PLUMBING
AND HEATING

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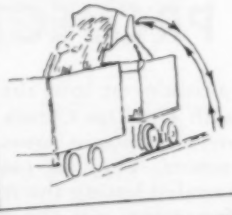
FOR EVERY PIPING SYSTEM

When every minute counts

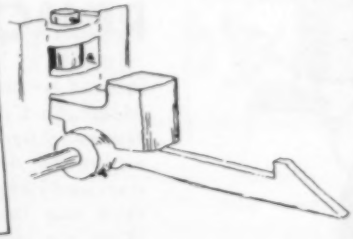
You can depend on an EIMCO

Saves Time Loading — Faster, more powerful bucket motion with EIMCO 5 cylinder reversible radial air motors.

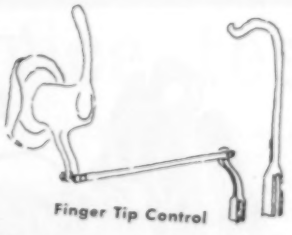


6 Seconds

Saves Time Switching — Efficient, tailor-made couplings fit the customer's car and save as much as 25% of time loading car.

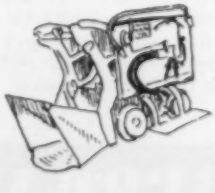


Saves Time With Operator — Easy moving, smooth operating controls make it possible for operator to do more work with less fatigue.



Finger Tip Control

Saves Time Out for Repairs — Rugged construction, anti-friction bearings and highest quality materials and workmanship assure lower maintenance costs per ton loaded.



Average service underground 4 years without repairs and before bringing out for checkup.

Your loader, with proper wheels and axles for your track, with proper arms and deck, bucket and coupler for your car, can be shipped on very short notice.

EIMCO

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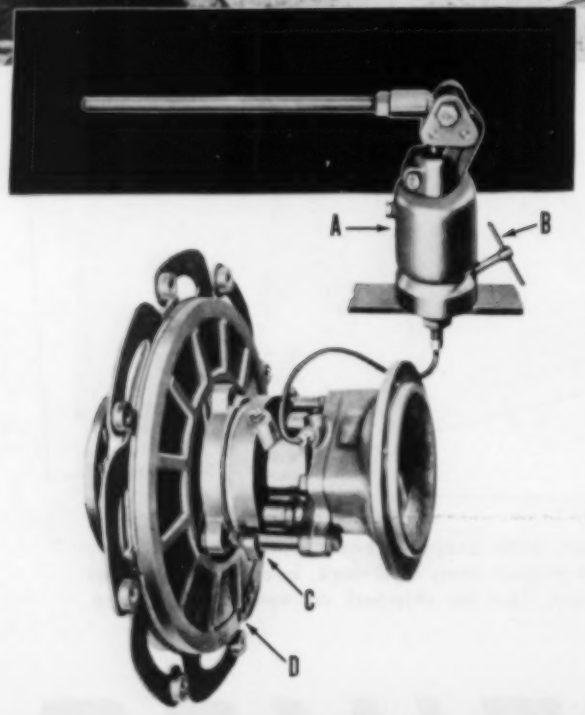


ON THE BIG ROCK REMOVAL PROJECTS

in heat or cold, in high altitudes or low, the I-R *Mobil-Air* Compressors with *Flex-Disc* Clutch and *Hydro-Shifter* are a reliable, continuous source of air to the drills and hammers. They are easy to start and keep going unattended letting the workmen stay on the job of getting out the rock. Here we see progress being made on the Colorado Big Thompson Project for water supply.

The *Flex-Disc* Clutch (D at left) meets the exacting requirements of portable compressor duty. Finger-tip hydraulic control is provided by the pump reservoir and handle (A) for disengaging, and the release valve (B) for engaging the clutch through the hydraulic jack unit (C). All parts are built for low maintenance and long service. The seldom needed replacements are readily made without disturbing the rest of the compressor.

INDUSTRIAL CLUTCH CORPORATION

Waukesha Wisconsin

performance proved by service tests

The promise of *lower cost per foot drilled* when you use CRUCIBLE Hollow Drill Steel is no idle claim.

Controlled hardenability, perfection of stress-bearing surfaces and uniform processing all contribute to your assurance of top quality. But to CRUCIBLE, this is not enough. CRUCIBLE *knows* you can expect *extra* performance because every lot is given an accelerated fatigue test which is correlated with actual granite drilling.

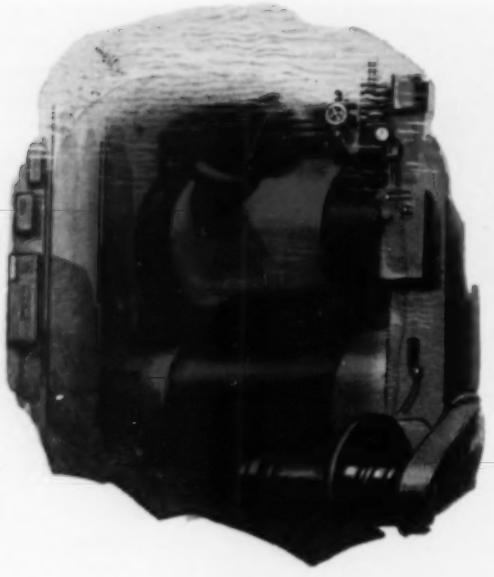
This is an *extra* CRUCIBLE service. It means that you can count on receiving lot after lot produced to chemical and structural uniformity—*proved* under actual drilling conditions.

Add to this: fast field service, unsurpassed metallurgical advice, country-wide stocks, and you can see why so many are saying, "Give me CRUCIBLE every time."

CRUCIBLE first name in special purpose steels

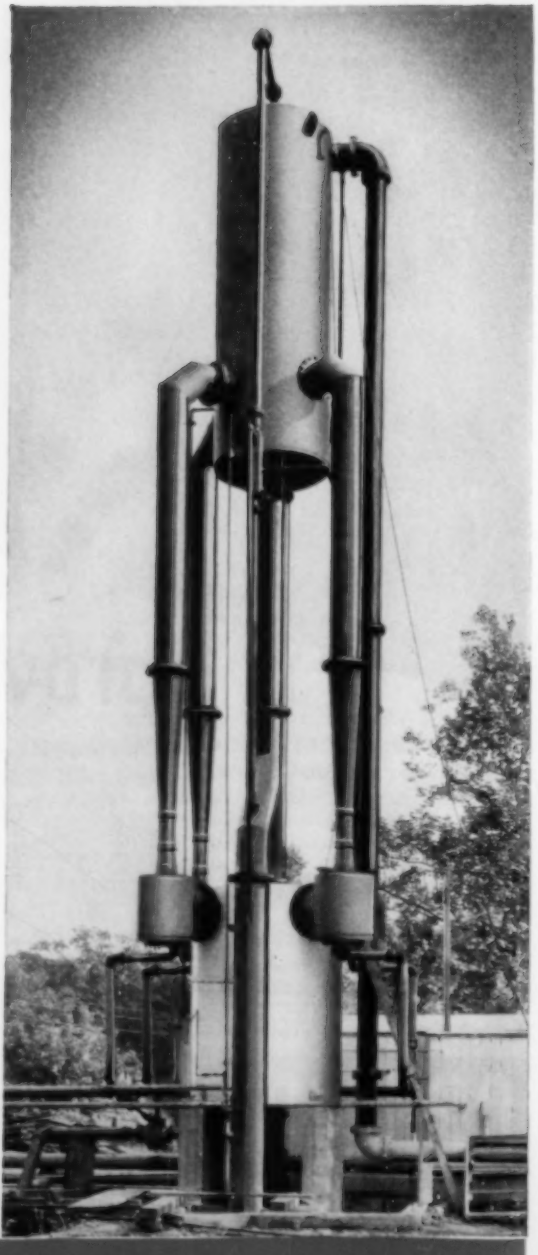
HOLLOW DRILL STEEL

CRUCIBLE STEEL COMPANY OF AMERICA, Chrysler Building, 405 Lexington Ave., New York 17, N.Y.
Branches, Warehouses, and Distributors in Principal Cities. Consult your Telephone Directory or Thomas' Register for Nearest Office.
HIGH SPEED • TOOL • STAINLESS • ALLOY • MACHINERY • SPECIAL PURPOSE STEEL



HOT!

isn't it*



* How about your process cooling water?

If these hot summer days have you wishing for a fool-proof way to get plenty of process cooling water—chilled to the exact temperature you need—then you'll like the simplicity and complete dependability of Ingersoll-Rand Water-Vapor Refrigeration. Check over the following features and you'll see what we mean:

- Capacities for single units range from 20 to 1200 tons of refrigeration for chilled water temperatures to approximately 40°F.
- Water is the only refrigerant . . . there are no toxic or expensive refrigerants to worry about.
- The water is cooled by direct evaporation in a high vacuum created by steam-jet boosters. It's as simple as the desert water bag of prairie schooner days, a small portion of water is evaporated giving sufficient cooling effect to chill the remainder.
- Operating economy is the same at all loads. Individual steam boosters can be turned off or on to suit load conditions, thereby reducing steam consumption in proportion to load.
- The units are entirely self-supporting. They can be installed outdoors and require very little foundation.

For complete details on the inherent safety and simplicity of Water Vapor Refrigeration, ask the nearest Ingersoll-Rand branch office for a copy of bulletin No. 9143-A.

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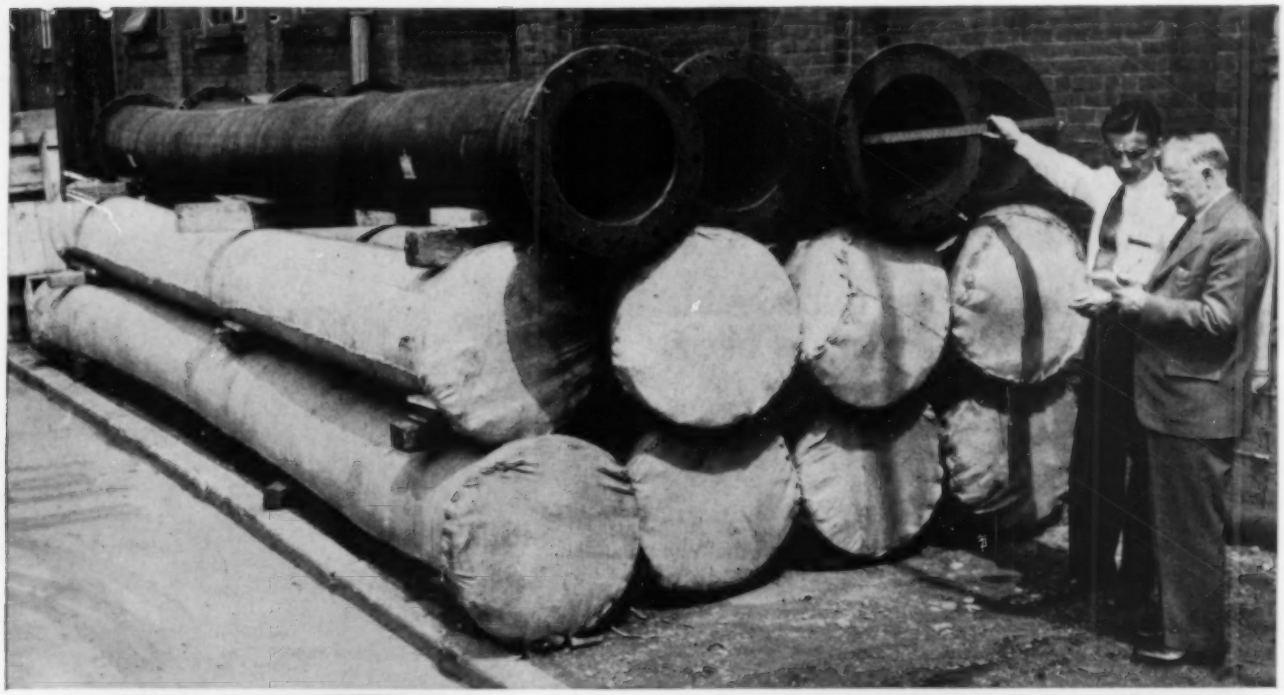
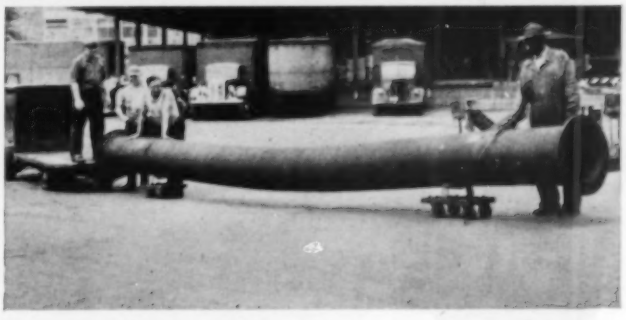
WATER VAPOR REFRIGERATION



LARGEST RUBBER HOSE



Engineered by Raybestos-Manhattan

A prominent southern chemical plant needed an unusually large, flexible, corrosive resisting line to discharge slurry through a narrow underground tunnel. It could be installed only by bolting together and drawing the entire line through — a tremendous strain on hose and flanges. The operation represented a large investment, a vital part of the process. They could not afford to take chances on anything but properly designed and engineered hose.

They gave the problem to Raybestos-Manhattan hose engineers. The result was the design and manufacture of what is believed to be the biggest rubber hose ever made in the long lengths required.

Pictured here are twelve 25′ lengths of 18″ I. D. Condor Flexible Rubber Pipe being checked by Raybestos-Manhattan engineers before shipment. One length of this huge hose weighs over half a ton . . . 1,425 lbs. Manhattan has made hose of larger diameters but, considering length, this is the biggest hose in its history.

If you have hose requirements, you can't go wrong by going to the men who are proved engineers of hose . . .

Keep Ahead with Manhattan

MANHATTAN RUBBER DIVISION — PASSAIC, NEW JERSEY

RAYBESTOS-MANHATTAN, INC.

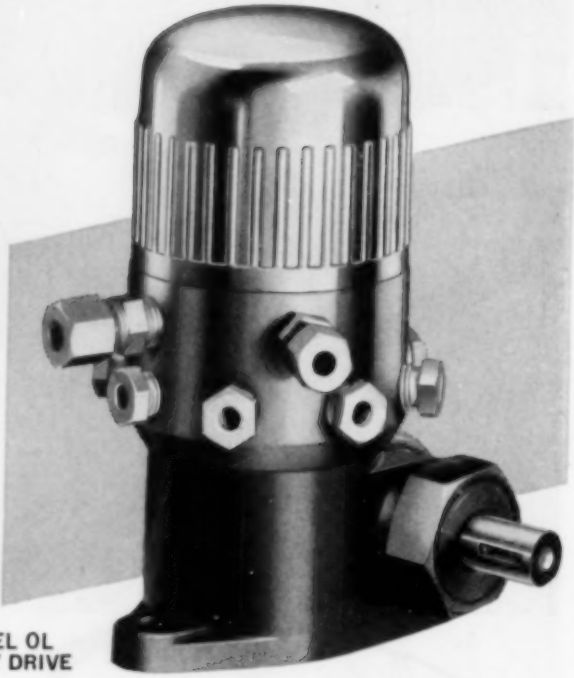
Manufacturers of Mechanical Rubber Products • Rubber Covered Equipment • Radiator Hose • Fan Belts • Brake Linings • Brake Blocks • Clutch Facings • Packings • Asbestos Textiles • Powdered Metal Products • Abrasive & Diamond Wheels • Bowling Balls

• • • • • • • • • • • • • • • • PRODUCT

MADISON-KIPP LUBRICATORS

Fresh Oil FED UNDER PRESSURE BY THE MEASURED DROP

The Model OL is the smallest in the series of six MADISON-KIPP lubricators. It is used where space is limited and for built-in applications in separated units of machinery where the most reliable type of lubrication is vital.



MODEL OL
ROTARY DRIVE

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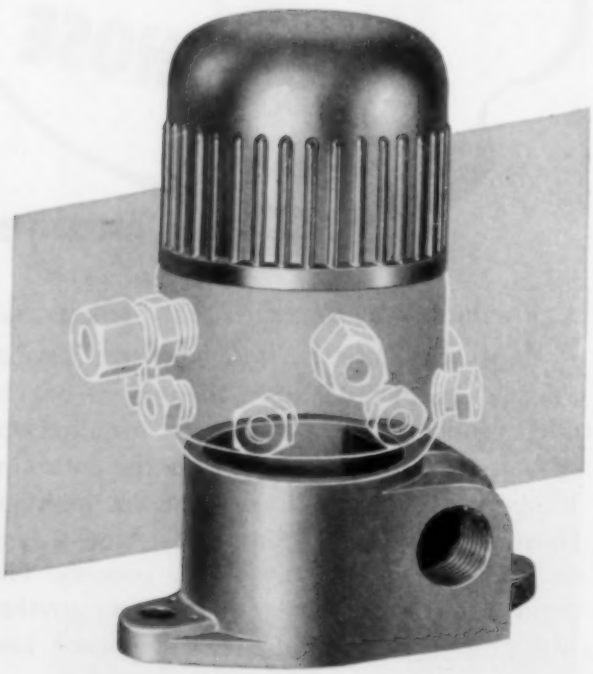
MADISON-KIPP DIE CASTINGS

IN ZINC AND ALUMINUM

Die castings as illustrated provide two important functions in the OL lubricator. They combine economical basic parts with pleasing appearance.

When you are designing new products, do not overlook the advantages of the die casting process.

Please send all your inquiries to the home office in Madison, Wisconsin.



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• *Skilled in* DIE CASTING *Mechanics*
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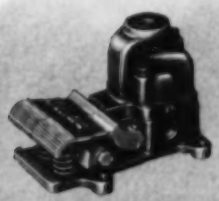
• *Originators of Really High Speed* AIR TOOLS

PRECISION MADE for LASTING SERVICE...

Hanna Valves

for every control problem

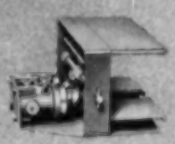
UNITITE—3-Way or 4-Way Valves . . . quick-acting, packless . . . for pressures to 250 psi. . . . in three mounting styles.



FOOT OPERATED—Either single or double pedal . . . for pressures to 250 psi. . . . provides quick, effortless control.

¼" UNITITE JR.—For light piping and tubing . . . control air, oil or water pressures up to 500 psi.

PILOT VALVES—3-Way . . . for direct control of small cylinders, automatic control of large cylinders or pilot for "Mastair."



FOOT PILOT VALVES — 4-Way . . . for hand-free control of small cylinders, automatic control of large cylinders—through "Mastair" Valve.

"MASTAIR"—Balanced spool type . . . controlled by one 4-Way or two 3-Way pilot valves.

SOLENOID—New 4-Way Valve . . . small, compact, low current consumption.

SPEED CONTROL—Regulates inflow and outflow of either air or oil independently to and from one side of piston.

You can be assured of long, trouble-free service with valves designed and made by Hanna—for Hanna Valves have a reputation throughout industry for excellent performance over the years.

In the equipment you design and build . . . in the equipment you use . . . specify Hanna Valves and be sure of the best. There is a Hanna Valve for every control problem.

Hanna Engineering Works

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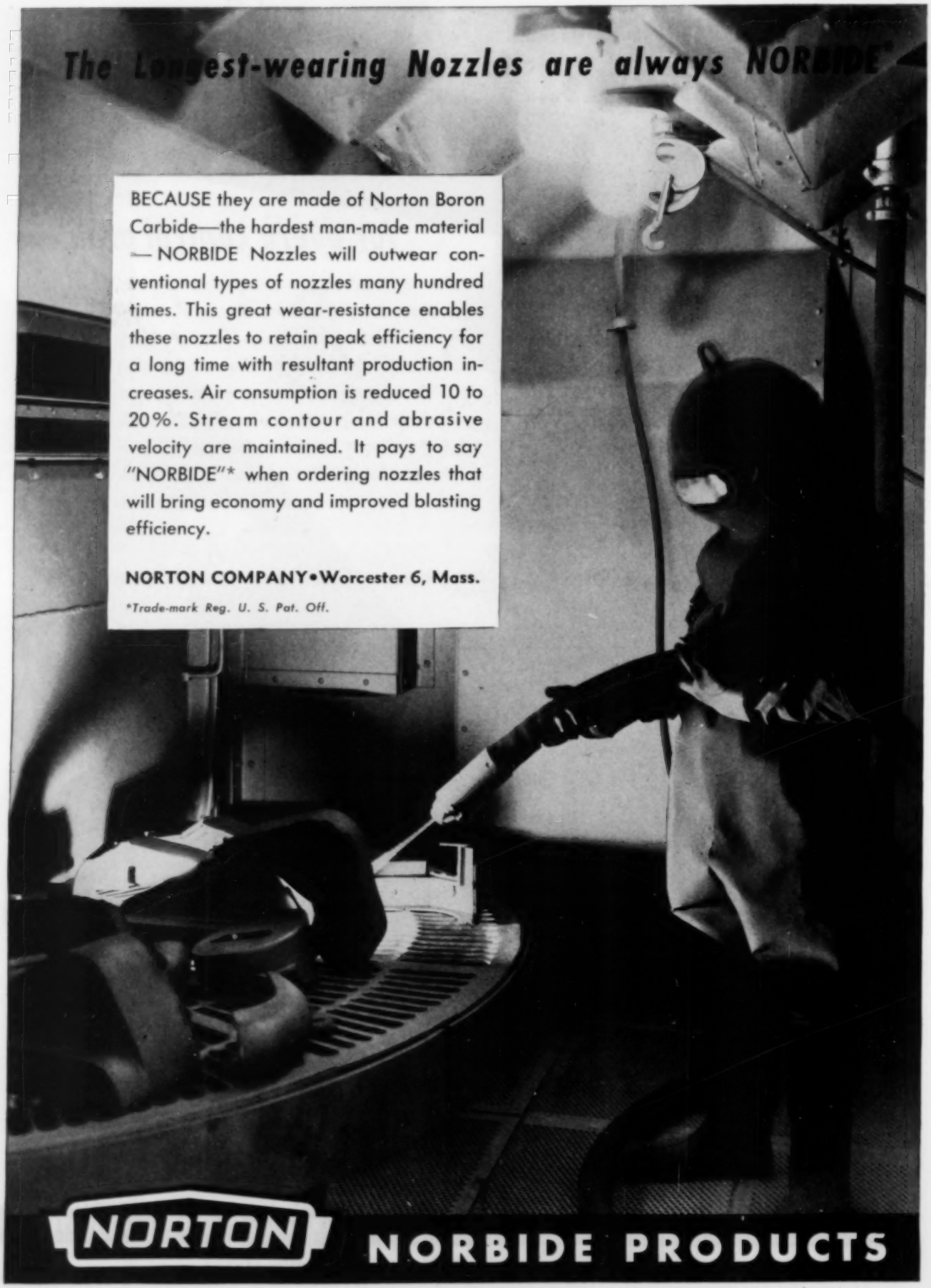
The Longest-wearing Nozzles are always NORBIDE
BECAUSE they are made of Norton Boron Carbide—the hardest man-made material — NORBIDE Nozzles will outwear conventional types of nozzles many hundred times. This great wear-resistance enables these nozzles to retain peak efficiency for a long time with resultant production increases. Air consumption is reduced 10 to 20%. Stream contour and abrasive velocity are maintained. It pays to say "NORBIDE"* when ordering nozzles that will bring economy and improved blasting efficiency.
NORTON COMPANY • Worcester 6, Mass.
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NORTON
NORBIDE PRODUCTS

ON THE COVER

THE economy of the mechanical rock drill is so well established that hand drilling is resorted to only where unusual conditions exist. Such a case is illustrated on our cover. The workmen shown are excavating a *levada* (irrigation canal) in a steep lava cliff on the Island of Madeira. They used hand equipment not by choice but by necessity, the region being too rugged to permit moving in air compressors.

IN THIS ISSUE

A PETROLEUM refinery is an aggregation of processing plants that can obviously make no money unless they are operating. In the case of a huge catalytic cracking unit, the cost of idleness runs into thousands of dollars a day. Nevertheless, all refinery departments must be shut down periodically for equipment overhaul. It is apparent that any time saved on these maintenance jobs means running time and adds to profits. Leading refineries have consequently systematized overhaul methods to get the units back "on stream" as soon as possible. This has led to the increased application of pneumatic tools, as our leading article points out.

•

AFTER four and one-half centuries of dreaming and fruitless planning, the Island of Madeira is tapping underground sources of water to increase the acreage of irrigated farmlands and to provide more electric power. Page 194.

•

REDUCING friction in machinery is such a big job in industrial America that some twenty concerns are engaged in making ball and roller bearings. One of the pioneers among them, The Timken Roller Bearing Company, has just rounded out 50 years of continually expanding existence. The story of its founding and growth is told in *Making Wheels Turn Easier*. Page 197.

•

THE cable railway originated on San Francisco's hills, and two lines still survive there despite modernization of most of the city's transportation network. An article on an ingenious rock-drilling rig used in tearing up other streetcar tracks gives us an excuse to show pictures of the fascinating cableway system. Page 200.

•

THERE is probably not an American city of appreciable size that does not have marble from Vermont in some of its structures. This beautiful stone has been quarried there for 80 years by one company, and in the postwar building boom its business is thriving. Two pages of pictures offer a cursory look at the industry. Page 202.

Compressed Air Magazine

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TIME-SAVING TOOLS

Pneumatic tools increase the refinery's earning power by reducing the time required to complete maintenance work on the various processing units during periodic shutdowns. Two of their many applications are illustrated. Below, a Size 555 impact wrench is being used to bolt up the flange on a high-pressure valve. The picture at the right shows an air drill with an angle attachment cleaning up a welded surface with a 3-inch brush.

Pneumatic Tools Keep Refineries Humming

C. H. Vivian

REFINERY FROM ALOFT

Gulf Coast oil refineries are huge affairs, as this picture attests. This establishment covers hundreds of acres and turns out a great variety of petroleum products. Maintenance of the numerous processing units is obviously a major factor in operating efficiency.

PETROLEUM refineries have developed highly systematized methods of doing the maintenance work necessary to keep them operating efficiently. The problem differs from that of the average manufacturing plant because a refinery goes on continuously—there are no night, week-end, or holiday shutdowns when machinery and equipment can be repaired. The refining of

crude oil embraces numerous processes, and the number in use in a particular plant depends upon its size and the scope of its activities. In all cases, however, the established practice is to operate each department as long as it functions properly and safely, and to close it for thorough inspection and overhaul only when necessary.

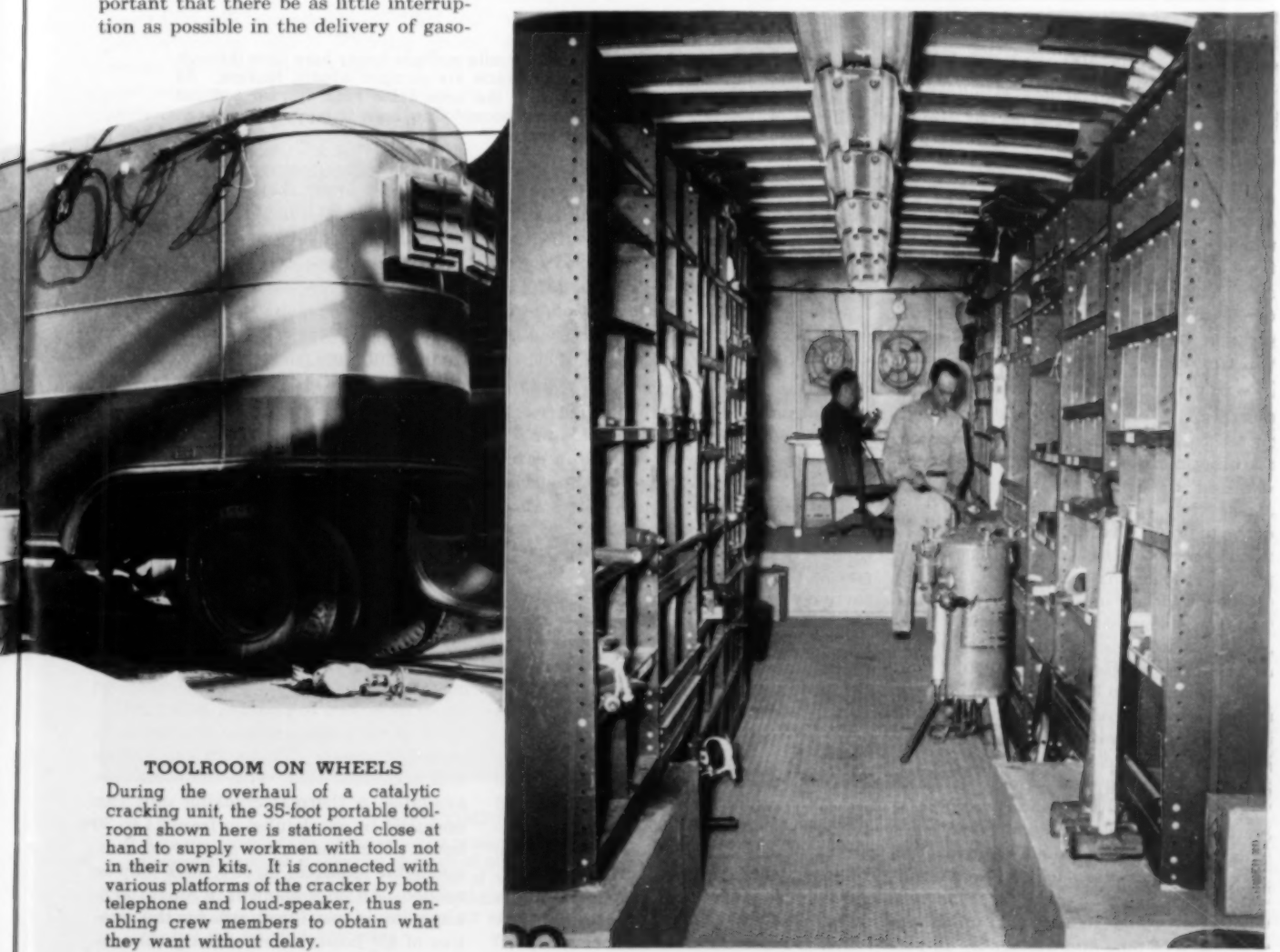
The length of the periods between maintenance in the different departments varies with the nature of the work they do. Besides, the equipment in some of them requires relatively little attention at each shutdown, while that in others needs considerable to put it back in good order. Regardless of these variables, the idle section of a plant brings in no returns on the money invested in it. Accordingly, the maintenance program has a twofold objective: reducing the down time to a minimum and doing what is needed so effectively that the ensuing operating period will be of maximum duration. This will obviously increase the refinery's over-all production or "throughput."

With the steady rise in the size and cost of equipment, increasing emphasis has been placed on refinery maintenance. During World War II it was highly important that there be as little interruption as possible in the delivery of gasoline and other vitally needed petroleum products to our military forces. It was then that the groundwork was laid for the present time-saving overhaul technique, which has been further improved meanwhile. Expressed briefly, the first step in the procedure followed is to make a thorough study of all the operations involved; and, second, to plan the work to be done with such care that the best combination of manpower and equipment is utilized in each case.

This approach to the problem has brought highly satisfactory results at a large Gulf Coast refinery which produces aviation-grade gasoline, motor gasoline, fuel oils, and diesel-engine fuels, as well as many kinds of lubricants and solvents. The plant is divided into five zones, in one of which are the various shops. The others are working zones, and each has its own craftsmen, including welders, electricians, boilermakers, pipefitters, riggers, machinists, painters, carpenters, and bricklayers. The company has instituted in its mechanical department a cost-control program that is designed to improve both the scheduling and performance of the work. Program policies are discussed and outlined at daily conferences of department foremen and supervisors. The latter, in turn, meet with the zone supervisors to coördinate the efforts of the entire personnel. After a job has been planned and a schedule drawn, a thorough check is made to see that the manpower and the materials and equipment needed are available to start and carry out the work.

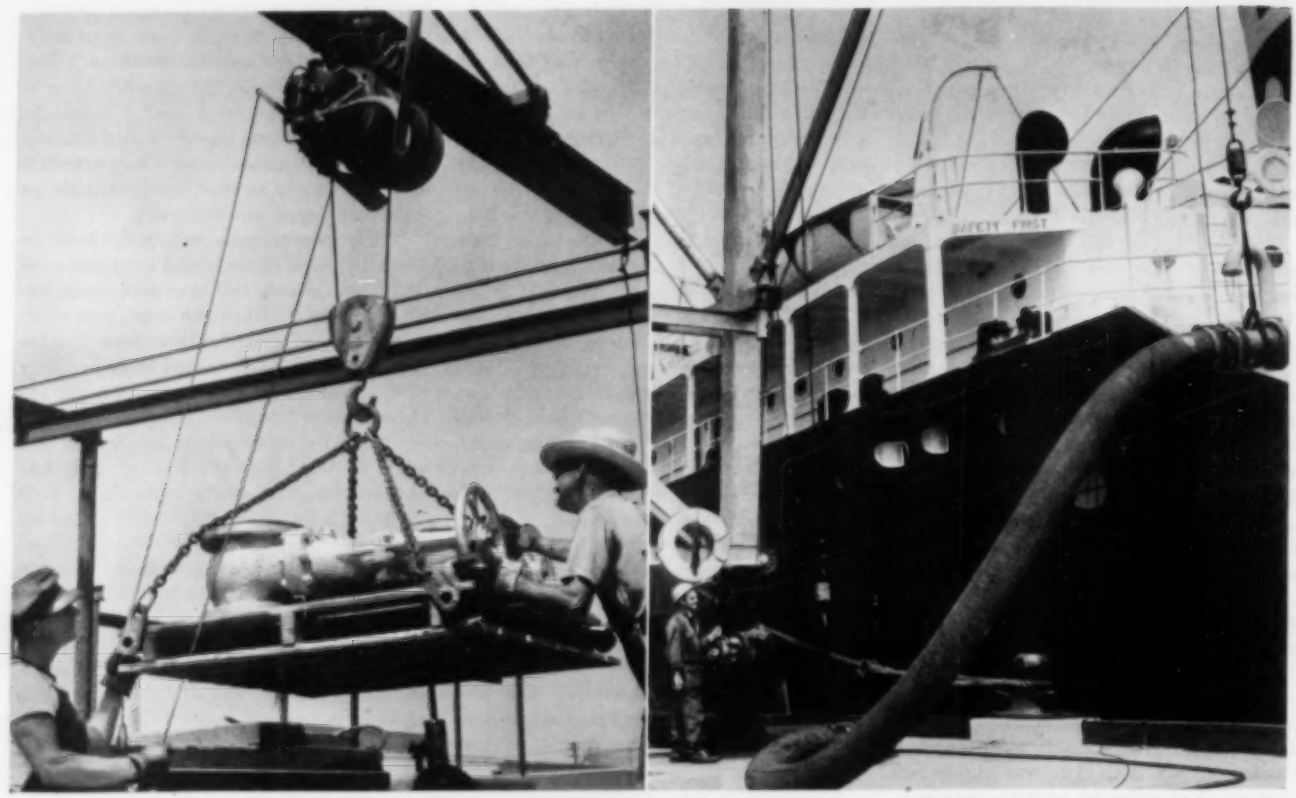
These conferences naturally lead to investigations of tools and equipment to determine which will best serve requirements. One result of the great care exercised in their selection has been the increased use of air-operated tools in many of the crafts. The boilermakers, for instance, have adopted pneumatic impact wrenches for removing and replacing bell caps on bubble-tower stills. This has speeded up the running of retaining nuts on bolts, a job that was formerly done by hand. By means of a special tool devised in the plant and utilized in connection with a pneumatic rivet buster, one man can now back tubes out of tube sheets, whereas two were required when that work was done with a maul and a backing-out bar. It is estimated that this change in method saves $1200 a year.

The boilermakers handle much heavy



TOOLROOM ON WHEELS

During the overhaul of a catalytic cracking unit, the 35-foot portable toolroom shown here is stationed close at hand to supply workmen with tools not in their own kits. It is connected with various platforms of the cracker by both telephone and loud-speaker, thus enabling crew members to obtain what they want without delay.



LIFTING WITH AIR POWER

More than 100 air-operated hoists make light work of lifting and transferring jobs, working tirelessly around the clock. A direct-lift hoist running on a swinging overhead beam is pictured at the left moving a skid load of valves during the overhaul of a refinery unit. At the plant wharf, 36 Size EU hoists handle multiple heavy hose lines through which refined products are pumped aboard tankers. As shown at the right, the hoist cable runs upward and out along a swinging boom. The hoist is equipped with an automatic air brake.

material, and the lifting is now largely done by air-operated hoists, some of which are mounted on two pneumatic-tired wheels to make them readily portable. It is estimated that a unit of this type saves $100 each time heat-exchanger tubes are cleaned by reducing the time formerly spent in raising and lowering the equipment used. Similar worth-while economies have been effected by hoists that have been adapted for other maintenance lifting, but all are dwarfed by those resulting from air hoists that run on trolley beams and serve to unload structural steel from railroad cars as well as stack it at the boiler shops. A locomotive crane was formerly utilized to do the unloading, and the material was then stacked by hand. Now both jobs are done by hoists at an annual saving of approximately $45,000.

Pipefitters also have found that pneumatic impact wrenches save time and use them whenever possible. Today, they are standard equipment for removing and replacing nuts on practically all vessels, drums, fittings, and valves, and perform all this work much faster than it could previously be done with mauls and hand wrenches. Replacement of a hand-operated winch by a portable air hoist in the agitator area has speeded up the installation of pipe and fittings by 25 per-cent and almost completely eliminated working hazards. Other air hoists substituted for mechanical hoists in the pipe-threading shop have improved working conditions and increased safety.

Although much aviation gasoline is made in catalytic crackers, some gasoline is still produced in conventional thermal cracking units that consist of reaction chambers and banks of tubes. There the hydrocarbon molecules are broken up by heat and under pressure and are reformed. Carbon deposits build up inside the system fairly rapidly, and every few weeks a unit has to be dismantled and cleaned out. There are twenty of them, and as they are given attention in turn there is enough work to keep a crew busy the year round. The operations are ordinarily directed by eleven foremen.

The reaction chamber, or soaker, is a vertical cylindrical vessel with flared conical sides and cover plates secured top and bottom by rings of large-diameter bolts. It was formerly a long and laborious task to remove and replace the retaining nuts. Now they are run off and on quickly with Size 555 pneumatic impact wrenches. The upper head is taken off first, then the bottom one. A hydraulic lift, permanently installed under each reactor, serves to support the wrench while the nuts are being run off and then to lower the heavy head. An Ingersoll-Rand Utility air hoist with a single line pull of 2000 pounds is mounted overhead to raise tools and materials. Assisting in this service are one or more portable hoists such as those already mentioned. These are stationed on the ground, and lines from them are run over pulleys secured at the highest available points. The pulleys can be moved about so as to deliver loads wherever desired.

The reaction chambers are cleaned with steam-driven rotary tools the working ends of which expand so as to reach all interior surfaces of the vessels with their flared sides and to remove the carbon. The tubes in the direct-fired heaters must also be cleaned. This is done by taking the plugs from the headers joining the banks of horizontal tubing and by inserting into the straight sections air-operated rotating tools similar to those long used in cleaning boiler tubes. Most of the tubes are 4 or 4½ inches in outside diameter. This work has been so well organized that, with the tools now available, a thermal cracking unit can normally be overhauled in from 24 to 30 hours. If extensive overhaul or replacements are required, up to a week may be needed. An improvement in repair technique lately instituted calls for the services of air hoists when making tube re-

placements. Heretofore, each new tube was elevated by block and tackle and then pushed in place by hand. Now it is both raised and inserted in one operation. The estimated annual saving resulting from this change in practice is $2500.

The super maintenance job of the refinery is the periodic overhaul of the catalytic-cracking units. Fortunately, cat crackers function for a long time before they have to be torn down for inspection and repairs. Months normally elapse before they require attention; one on the Pacific Coast completed a record run of 610½ days last summer. Preparations for the overhaul, or "turnaround," as it is known, may be likened to the planning of a large-scale military operation. It is a highly complicated and costly procedure.

In the interest of saving time and money on the job itself and of performing it so well that the period of the ensuing run will be of the longest possible duration, every detail is worked out in advance. The stage is set as carefully as that for a Broadway theatrical production, with every "prop" accounted for. A day-by-day schedule is drawn up, each man is assigned his part, all materials are made ready, and each item of equipment that will be needed is provided and put in proper order. Planning starts weeks and even months ahead of time, and keymen hold daily conferences to systematize the operation. Each turnaround yields valuable pointers, and these are noted for future reference.

The mechanical craftsmen are picked for the job from the various refinery zones, the ones most skilled being selected. In the case of a recent overhaul of a cat unit, 521 men were employed. They worked around the clock in three 8-hour shifts, with about half the total force on daytime duty. Hardly a minute was wasted, and the great steel structure was gone over well-nigh inch by inch. Thanks to the thorough organization, the unit was back "on stream" in sixteen days.

Each craftsmen in the turnaround crew has his own tool kit. If something he needs isn't in it, he can get it quickly from a 35-foot-long moving-van trailer that is stationed close at hand. Telephone connections on each landing of the cracker enable him to request what he wants, and there is also a public address system to facilitate communication. If, despite careful stocking, the tool required is not on the van, a "hot-shot" truck speeds to the toolroom to get it.

All told, some 5000 tools are called into play, and many of them are air-powered. Virtually all dismantling and assembling is done with the latter. Compressed air is piped to every landing, and manifolds with multiple outlets are provided at regular intervals. In addition to operating tools, the air is used to blow out pipe lines on the cracking units if they have become obstructed in service.

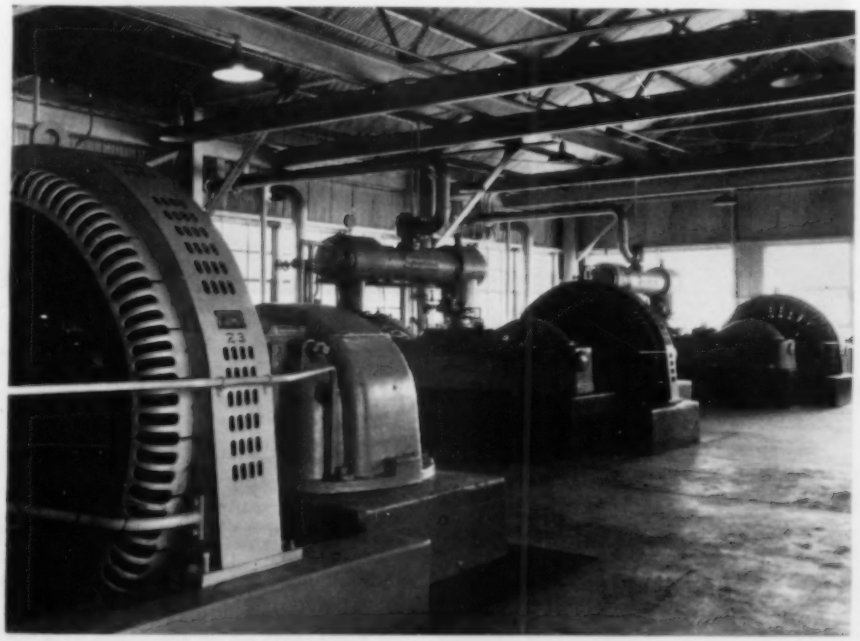
Whenever a refinery unit is dismantled for overhaul, all instruments are checked for accuracy and efficiency. This is done in a shop especially equipped for the purpose. It has overhead air hoists on booms for handling heavy loads, and compressed air at a pressure of 100 psi. is piped to all working tables for operating pneumatic tools and for removing metal chips. An Ingersoll-Rand Type 30 two-stage, air-cooled 3-hp. compressor driven by an electric motor furnishes air at 500 psi. for testing the diaphragms of safety valves. About 5 percent of the valves require still higher pressures, and this is obtained by boosting the 500-pound air in a receiver—by introducing water from the discharge of a triplex piston pump.

Compressed air is used for many purposes throughout the refinery. It operates Guniting and sandblasting outfits, grease guns for lubricating various pieces of equipment, vibrators for loosening sand and clay in some of the processing vessels, and tie tampers for compacting ballast on the plant railroad line. There are so many oil-storage tanks on the grounds that the painting of some of them is contracted to outside parties. Old paint and rust are removed with chipping hammers, sandblasting units, and pneumatic buffers, and a 2-inch air line is run to every tank.

In the case of extensive repairs, which generally call for pneumatic riveting hammers, additional air is supplied by portable compressors. Small air-operated sump pumps do miscellaneous pumping jobs at different locations. Some of these are of all-bronze construction for the handling of acid liquids. At the wharf, where tankers are loaded with finished products for delivery to various points, the transfer is made by the aid of 8-inch rubber hose lines that are moved about as desired by 36 Ingersoll-Rand Size EU air hoists.

There are nine toolrooms in the refinery and one of them is devoted exclusively to the repair and maintenance of air-powered tools. In addition to servicing 100 pneumatic impact wrenches and more than 100 air hoists, it takes care of drills, grinders, scaling and chipping hammers, riveting hammers and rivet busters, sump pumps, and other special equipment.

Two main compressor stations furnish air for general plant purposes, and piping extends from them to all parts of the grounds. The newer station houses two 300-hp. XRE and one 700-hp. PRE synchronous motor-driven units and two 300-hp. XVG gas-driven machines—all of Ingersoll-Rand type. One of the latter provides air at 60 psi. pressure for pneumatic instruments that control the various refining processes. The other units discharge at 110 psi. The operation and supervision of the compressed-air system is under the utilities department which supplies water and electric and steam power for the entire refinery.



AIR COMPRESSORS

A partial view of one of the two compressor plants that serve the refinery with air delivered through a network of miles of piping. Shown are two 300-hp. synchronous motor-driven units and one end of a 700-hp. machine. All discharge at a pressure of 110 psi. In addition, the building houses two 300-hp. gas engine-driven compressors one of which furnishes air at 60 psi. for operating instruments that control the refining processes.

Madeira Digs for Water

Tiny Atlantic Island is Realizing a Dream More Than Four Centuries Old

G. A. Golson

MADEIRA SCENERY

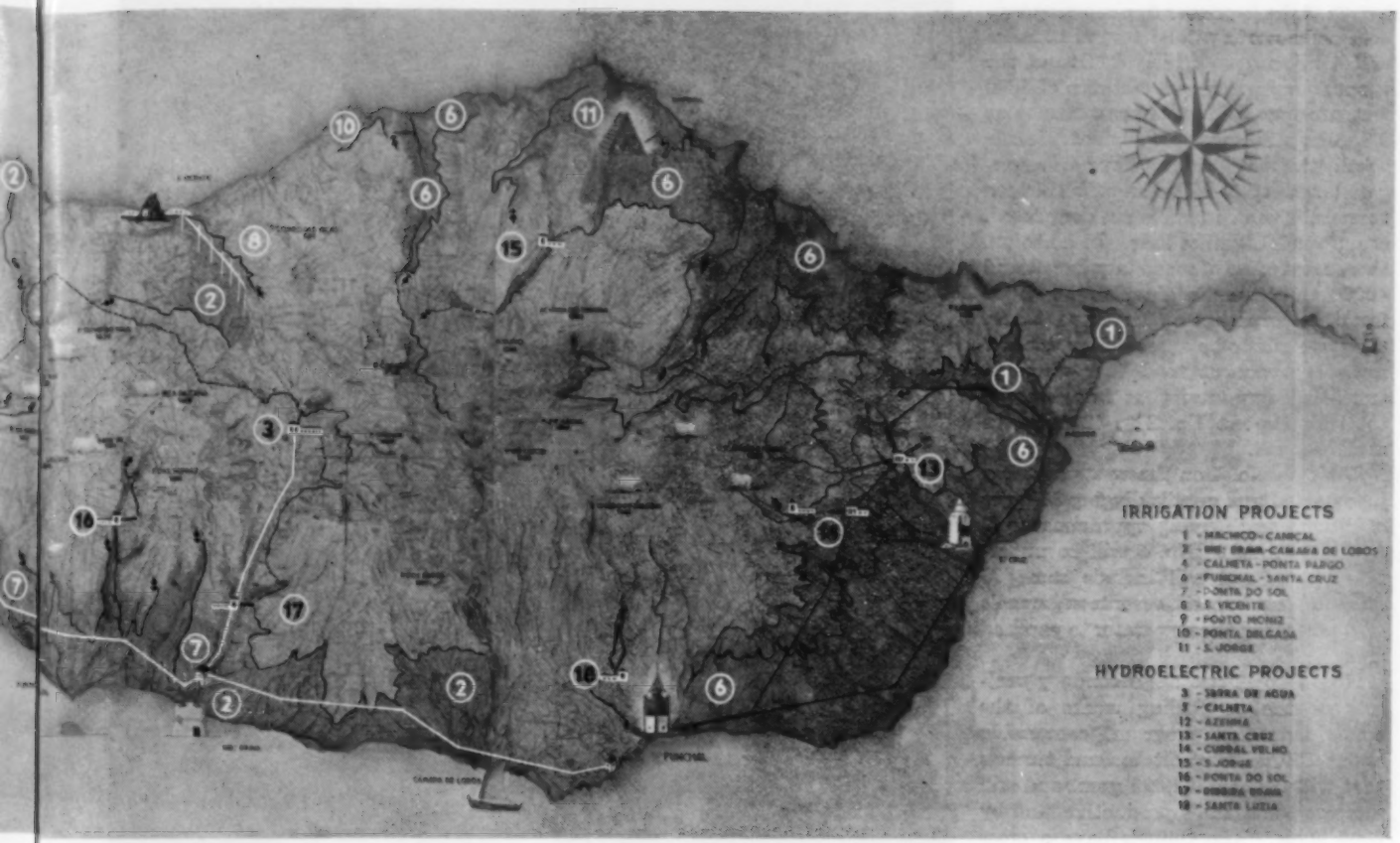
Although it is little known to American travelers, Madeira has many tourist attractions, including beautiful scenery. A view of the capital city on the Bay of Funchal is seen above. The picture at the upper left shows typical vegetation. Wild orchids are growing on the large tree in the center.

JUST about 600 miles southwest of Portugal lies the Island of Madeira, a small body of land in the Atlantic Ocean that has been known for a long time by the globe-trotting British but is seldom visited by Americans. It is chiefly known for its sweet wines and its embroideries, though the latter are often beyond the purchasing capacity of the average housewife's pocketbook. However, few people in the United States are aware of the fact that it is one of the most beautiful, comfortable, and reasonably priced tourist resorts now to be found on the world's travel lanes. This little dot in the middle of the Atlantic is, strangely enough, one of the most densely populated spots on the face of the globe.

Madeira is a volcanic island, 35 miles long and 15 miles wide, with an area of 276 square miles. It has very little flat lands, and the terrain rises steeply from the coast to elevations anywhere between 4000 and 6000 feet. Most of the arable lands have accumulated on the steps of lava flows, which were erupted many thousands of years ago from now filled-in volcanoes. These limited cultivable spaces are occupied by an estimated 3750 inhabitants per square mile who make their living tending the vines that produce the famous Madeira wines and grazing flocks that yield dairy products exported mostly to Portugal. The women, meanwhile, sit on their doorsteps in the balmy climate embroidering, hours on end, the artistic designs which have made the island famous for its linens. It can readily be gathered that the standard of living under such conditions is low, and it has been and is one of the great concerns of the Portuguese Government to alleviate the misery that has been the lot of these people for so many years.

It is an unfortunate fact that the life-giving rains seem to fall mostly on the northern part of the island. The reason for this is that the peaks which rise high above the general topography help to precipitate the moisture in rain-bearing clouds. The water rushes down the northern slopes, either running into the sea or collecting on plateaus where, through the centuries, it has been gradually absorbed and formed an immense enclosed reservoir from which springs and torrents issue at points on both sides of the island.

As far back as 1493, some 85 years after the discovery of Madeira, it was proposed to make this tremendous reserve of water available to its less-favored southern section. There Funchal, the capital, is located and there some 90 percent of the island's 275,000 inhabitants are congregated because the


IRRIGATION PROJECTS
1 - MACHICO - CANICAL
2 - [illegible] - CAMACHA DE LOBOS
4 - CALHETA - PONTA PARGO
6 - FUNCHAL - SANTA CRUZ
7 - PONTA DO SOL
8 - S. VICENTE
9 - PORTO MONIZ
10 - PONTA DELGADA
11 - S. JORGE
HYDROELECTRIC PROJECTS
3 - SERRA DE AGUA
5 - CALHETA
12 - AZEVINHA
13 - SANTA CRUZ
14 - CURRAL VELHO
15 - S. JORGE
16 - PONTA DO SOL
17 - [illegible]
18 - SANTA LUZIA

KEY TO THE PROGRAM

Irrigation systems are indicated by white numbers and power generating stations by black ones. Solid lines, some in white and others in black, designate canals or "levadas." Dotted lines indicate tunnel sections.

region is protected from the prevailing winds and because the climate is mild. But these advantages, unfortunately, are offset by a shortage of water for power and irrigation. In 1770 the plan was again taken under advisement by Don Jose I, then the reigning head of Portugal, but again without success.

It has been calculated that of the entire population only 78,000 people are able to cultivate the land. Of these, approximately 23,000 are located in the irrigated areas, while the remainder eke out a meager living among the arid rocks. The Portuguese Government became more and more conscious of this state of affairs when immigration of Madeirans to the United States and Venezuela increased at an alarming rate. It was this exodus that finally brought the long-standing scheme for the welfare of the islanders to fruition. Actual work on the project was started about two years ago, and it is scheduled to be completed by 1951. It involves tapping not only the underground reservoir but also the northern flow and providing hydroelectric plants, tunnels, and irrigation canals, known as *levadas*.

The accompanying map gives a general idea of the extent of the plan. The white numerals in white circles represent irrigation works and the black figures encircled in white are waterpower installations. Taking the former in the order mentioned:

No. 1 is about completed. It connects two valleys on the east coast and includes two tunnels, 2300 feet long, and approximately 10 miles of ditches.

No. 2 is an extensive network of canals and tunnels that will supply water for cultivation to a small part of northwestern Madeira and a large section of the densely populated southern shore. The

AIR POWER ON THE HEIGHTS

Wherever possible, muscular effort is supplemented by air-driven tools. At the extreme left edge of the large picture is stationed a 210-cfm. Mobilair compressor from which an air line extends along the face of the cliff to the right, where a tunnel is being driven. A close-up of the compressor is shown in the inset. It is located near the northwest coast and at an altitude of 3000 feet.

length of the *levadas* and connecting tunnels in the north will be around 10 miles and 4 miles, respectively. Nine of the tunnels, representing a distance of 3800 feet, are open, and of the ten others some 2.5 miles still have to be drilled. In the south, the main ditches have an aggregate length of 15 miles, and the thirteen tunnels, of which twelve are completed, are around 1.3 miles long. In addition, there are 4 miles of secondary canals and 4000 feet of tunnels of which only 1000 feet or so remains to be excavated. Later, the system is to be extended by about 7 miles of open cut to deliver water to small-scale growers, thus bringing the total for Project No. 2 to 42 miles, in round figures.

Work on No. 4 on the west coast has just started and entails digging 38 miles of ditches and driving approximately 3 miles of tunnels. No. 6 will be undertaken soon and will include some 75 miles of *levadas* and seventeen tunnels 4.75 miles long to carry water to parched areas.

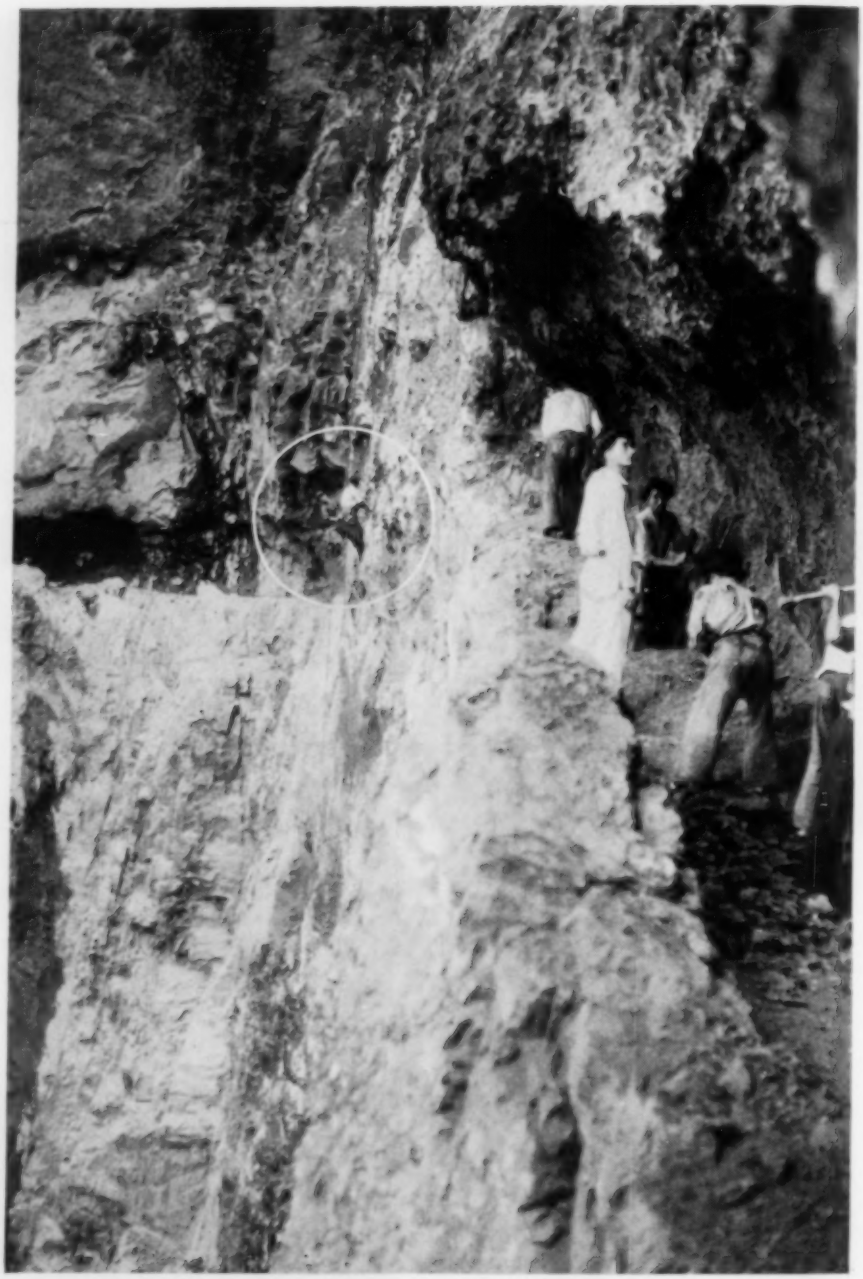
Nos. 7 to 11 are the secondary projects or the concluding works of the whole irrigation program, comprising about 150 miles of ditches and tunnels that will convey 192,000 gpm. and will increase the island's productive land by 6000 acres. The tunnels have a cross section of approximately 5x6 feet and the canals, most of which have to be chiseled out of basaltic rock, are around 4x1½ feet in section.

Waterpower development is still in the initial stage, for of the nine stations to be built operations are underway on only No. 3. Rock drilling has been completed except for the penstocks, which will have a drop of 1300 feet, giving the turbines a maximum capacity of 1800 kw. Bids on the electrical machinery for this station are shortly to be made public. When completed, the total output of the proposed hydroelectric system will be 6000 kw., increasing the energy now available from thermal sources to around 10,000 kw.

Just what the jobs involve can be grasped from the accompanying photographs. Workmen virtually have to be alpine climbers to reach the rugged heights at which the canals and tunnels are being driven in the fragmented, unpredictable formations of basaltic lava. Wherever possible, excavating is being done by Jackhamers of the JB4 or J50 Ingersoll-Rand type supplied with air by portable compressors mostly of 210-cfm. capacity. Some of these units have been pulled up laboriously along mountain trails carved into the sides of cliffs 2000 and 4000 feet steep.

But there are places so jagged and precipitous that the men have to use hammers and steels as in the days before air-operated rock drills were invented. Lately, however, attempts have been made to hoist small compressors—the new Pacair introduced by Ingersoll-Rand—up vertical cliffs to eliminate hand labor that has at times made not more than a foot of advance a day. These machines will be operated in conjunction with lightweight J-10 Jackhamers. Most of the contracts now underway have been awarded to the Sociedade Madeirense de Empreitadas, Lda.

It is estimated that the cost of the program, including irrigation and hydroelectric projects now in progress or about to be started, will exceed $4,500,000. When all the available water is finally tapped to make barren lands fertile and to provide more electric power to turn the wheels of industry, Madeira will at last see the realization of a plan that it has nurtured for 456 years. The standard of living of the inhabitants will undoubtedly improve measurably, and even the tourist will benefit because irrigation will permit raising greater quantities of bananas, sugar cane, grapes, and passion fruit, making the island, with its semitropical flowers and vegetation, more verdant and lovelier than it is.



CARVING OUT A "LEVADA"

This view and our cover picture illustrate some of the difficulties that are experienced in excavating ditches in the steep and lofty lava slopes. Note the two men in the circle who are suspended from ropes. There is a sheer drop of 1800 feet below them. The "levadas" are about 4x1½ feet in section and most of them are being hewn out of basaltic rock.

Making Wheels Turn Easier

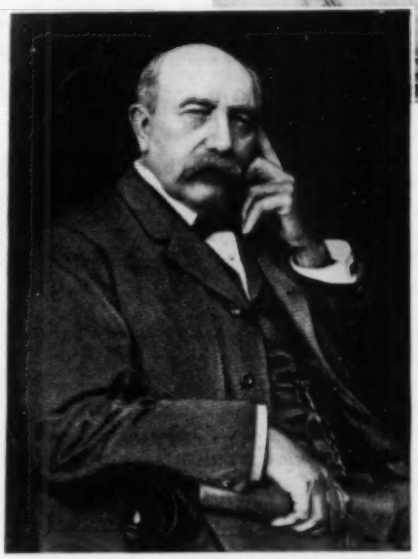
The Story of Timken Roller Bearings

THE wheel, rated by some authorities as the greatest of all inventions, did not come into full utility until modern bearings were applied to reduce its turning friction. Among antifriction bearings, balls came first and were followed by rollers. The purpose in both cases is to convert sliding friction of ordinary bearings into rolling friction. Roller bearings distribute the load over a greater bearing area than balls and, consequently, are advantageous where considerable weight has to be borne.

One of the earliest contrivances to use ball bearings was the bicycle, and the first industrial machine in which they were incorporated was perhaps the mine car. A pioneer application was made around 1890, when bearings of this type were placed in the main journal of the Lick Telescope on Mt. Hamilton in California. With friction rolls, the 4½-ton, 56-foot-long tube was moved with difficulty, but it could be turned with the pressure of but 4 pounds on one end after it had been balanced on a series of roller bearings 2½ inches in diameter and 3 inches long.

Needless to say, the great mechanical development in the United States during the past few decades has fostered the bearing-manufacturing industry, and its importance in a nation that depends so much on whirring shafts and wheels is obvious. One of the leading firms in the group, The Timken Roller Bearing Company, reached its fiftieth year of existence in June and celebrated the occasion with five days of open house at its eight domestic factories and at one Canadian plant. During its half-century of activity, Timken has produced some five billion bearings ranging in weight from 2 ounces to 9068 pounds, and their application has expanded until they are now found in automobiles, railway locomotives and cars, airplanes, ships, and virtually every type of industrial machinery.

The Timken story follows the familiar American free-enterprise pattern. The firm's founder, Henry Timken, was born on a farm near Bremen, Germany, in 1831 and was brought to this country when he was seven years old. The family lived for a time in St. Louis, Mo., then moved to a farm near Sedalia in the same state. Henry, one of seven children, attended a country school until he was sixteen, when he apprenticed himself to a wagon builder in St. Louis. Eight years later he started his own carriage factory, which he left after five years to try his hand at making a fortune in the Colorado gold fields.



FOUNDER AND EARLY PLANT

German-born Henry Timken began building horse-drawn carriages in St. Louis in 1855, patented a widely used buggy spring in 1877, and then retired to California. In 1894 he returned to St. Louis, built the factory shown at the top, and re-entered business with his two sons. When bicycle ball bearings proved unsatisfactory for wagon axles he devised a tapered roller bearing from which the current Timken enterprises have sprung. The firm produced 48 million bearings in 1948.

But luck was not with him, and upon his return from that venture he again engaged in carriage manufacture until the Civil War broke out. He served more than three years, going back to St. Louis in 1864. Shortly thereafter his plant was destroyed by fire, but he rebuilt it and ran it until increasing business necessitated larger quarters in 1877. At that time he patented the Timken buggy spring, which was so successful that he retired a few years later and moved to California. Tiring of inactivity, he returned to St. Louis in 1894, put up another carriage factory and took his two sons, William R. and Henry H., into the firm.

Attempts were being made to use bicycle ball bearings in carriage and wagon wheels, but they were not suitable for the heavier service and the elder Timken spent a lot of time trying to devise a type that would be satisfactory. While lying sick in bed he made a drawing of a tapered roller bearing. As soon as he was able to get up he turned the sketch over to his sons, directing them to make a set by hand, and then left for San Diego, Calif. The boys produced some of the required parts, bought others, and eventually turned out bearing-equipped axles for a wagon.

Certain that reduction in friction would make it easier to pull a load, they heaped a wagon high, hitched two small mules to it, and started it off to a railroad station 4 miles away. Perhaps they anticipated what the result would be and were shrewd enough to capitalize on it. In any event, the driver soon telephoned that he had been arrested for cruelty to animals. William went to the police court with one of the bearings, persuaded the magistrate that the mules were not overtaxed, and the case was dismissed. The incident received widespread publicity and brought the elder Timken back from San Diego. Following several years of experimentation to improve the bearing, he patented it in 1898 and a year later turned the development over to his sons, this time for good.

The brothers formed a new company —The Timken Roller Bearing Axle Company—in 1899. Continuing to operate their father's carriage factory, they set aside a small space where they assembled bearing-equipped axles from parts manufactured for them by other concerns. The business expanded so rapidly that they decided to construct a new plant and make the bearings themselves. Until then, axles had been incorporated only in horse-drawn vehicles, but the auto-

mobile was in its infancy and the Timkens foresaw enormous possibilities in that field. With an eye to freight rates, source of steel, and proximity to the sprouting automobile factories, they investigated various locations and chose Canton, Ohio. Since that time Canton has been the hub of Timken bearing activities.

That decision made, they sold the lucrative St. Louis carriage plant and, in 1901, erected a 75x100-foot building in Canton. By the end of the year 50 employees were assembling bearings and axles for carriages, wagons, and automobiles. When a general business recession swept the country in 1902, the brothers devoted their spare time improving front and rear axles for automobiles. As a result, they had a better product to offer when business picked up. That experience set a standard company pattern—turning slack periods to advantage by engaging in research.

By 1908 the automobile was an established transportation medium. The demand for bearings increased so fast that the brothers decided to reorganize and to handle bearings and axles separately. Accordingly they formed The Timken Roller Bearing Company and The Timken Detroit Axle Company, locating the latter in Detroit because that was the focal point of the automobile industry.

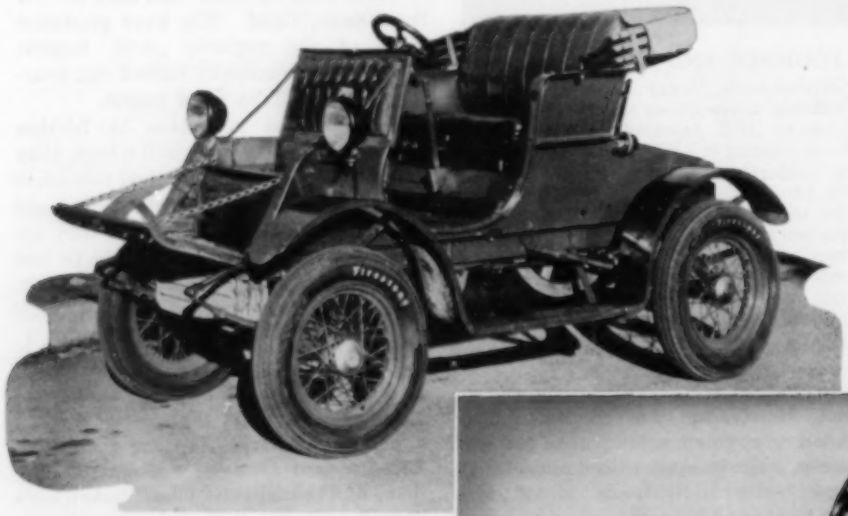
The output for the product of the automotive field expanded during the ensuing decade, which was further marked by the development of bearings for industrial machinery. Soon they were being applied to mine cars, machine tools, and farm equipment. During this period the company established its own steel mill to control the quality of the alloy steel it used. The first facilities went into operation in 1916. They have since grown into a mile-long plant extending from Canton into neighboring Gambrinus, and there is another mill in Wooster, Ohio. When production exceeds consumption in Timken factories, steel is sold to other manufacturers, even to competitors.

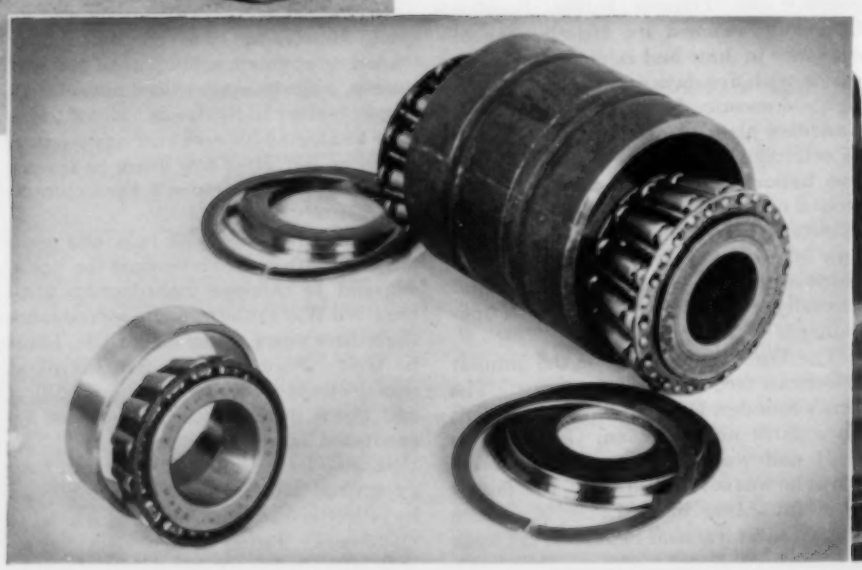
By that time the Canton plant had absorbed all the skilled labor available, and as the demand for bearings and other products that had been added was still growing meanwhile a new establishment was opened in Columbus, Ohio, in 1919. As soon as that was functioning smoothly, the company turned its attention to applying roller bearings to railway equipment. The trend towards faster passenger trains and longer freights placed emphasis on friction and its reduction. With the old-style journal-box bearings, "hot boxes" were a serious problem, especially on freight cars. The railroads wanted to remedy the situation, but as a freight car spends about 90 percent of its time on competing lines, the roads hesitated to put up the money. As this limitation did not apply to locomotives and passenger coaches, it was natural that they should be the first to have bearings.

In 1923, Timken started experiments on an interurban street car running between Cleveland and Canton. It was successful, but the steam roads were hesitant about adopting the innovation. Finally, the Chicago, Milwaukee, St. Paul & Pacific came to the conclusion that it would have to put on longer, faster trains in order to meet competition offered by other lines and buses. In 1926 it decided to provide its locomotives and 131 passenger cars with antifriction bearings. When bids were asked for, Timken got the order, and in 1927 the Pioneer Limited began to run between Chicago and Minneapolis-St. Paul as the first Timken bearing-equipped train.

In 1928-29 the New York Central put roller bearings on the leading trucks of 35 locomotives, and the Burlington followed suit with one unit. In the case of driving axles, application was stymied because frames were too small to accommodate bearings of sufficient size to carry the great weight involved. The railroads didn't want to assume the extra cost of larger frames. To break this impasse, Timken ordered a locomotive to its specifications and loaned it, over a period of eighteen months, to fourteen roads for trial. It was sold to the Northern Pacific, which still operates it. Those demonstrations led three lines to provide all axles on some of their locomotives with bearings. Today, every locomotive built uses antifriction bearings at hard-service points.

The next step was to tackle the freight-car bearing problem in earnest. To prove the merits of its products, Timken furnished the Pennsylvania Railroad with roller-bearing trucks for a





AUTOMOBILE BEARINGS

Rear-axle bearings that were used in a Dorris car 40-odd years ago are shown at upper-right in the view at the right. Those at the lower-left, which differ only in detail, are for a modern automobile. The basic principle of tapered rollers operating between tapered races is still retained. The first car equipped with Timken bearings in 1899 (above) is still in running condition.

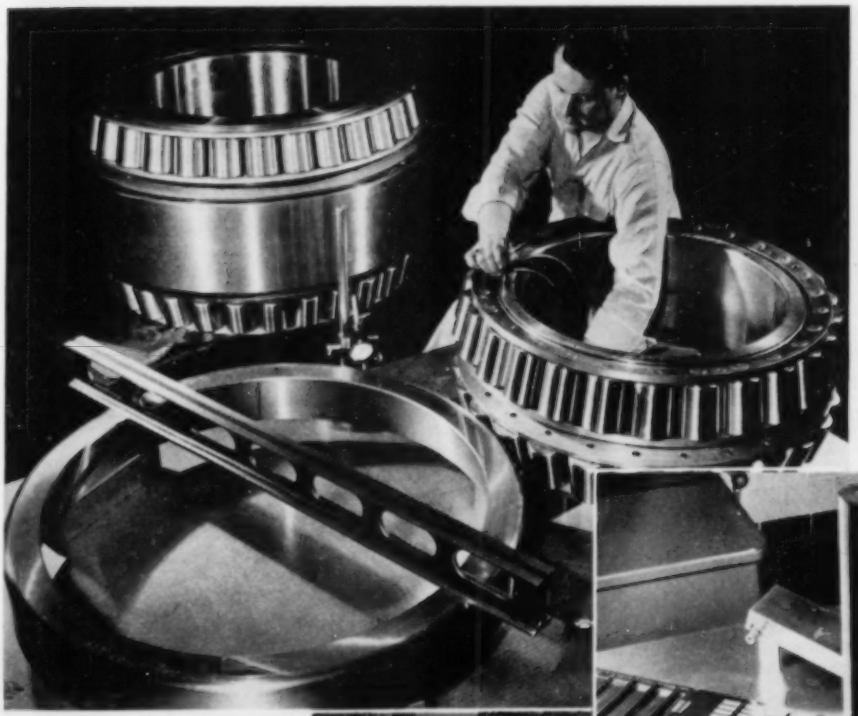
100-car train of 70-ton hopper cars for hauling coal. The advantages of antifriction bearings in that service were clearly demonstrated, but they were largely lost when some of the cars had to be switched on to other trains to reach their destinations. This factor set up sales resistance, but some lines gradually began to use roller bearings on certain cars that were to be kept together in one train.

In 1939, the Union Pacific equipped a 10-car merchandise freight train to run on a fast schedule. Several years later, it provided 300 cattle cars with roller bearings to cut the delivery time of livestock to markets so as to eliminate the necessity of stopping for periodic feeding. These worked out so well that 500 additional cars were ordered. A few years ago, the Chesapeake & Ohio bought 1000 hopper cars with Timken bearings for carrying coal. Although only a small percentage of the nation's freight cars have antifriction bearings, there is a definite trend towards their use and every reason to believe that both freight and passenger trains will ultimately run in more or less the same speed range.

During World War II, Timken manufactured bearings of all types and sizes for fighting equipment and for machines utilized in hundreds of plants turning out war-related products. In addition, it made 100,000 barrels for 37-, 40-, and 75-millimeter guns for all branches of the service. In those years and since, continually increasing demand for its products has been met by building new plants to bring the total in the United States to eight. For more than twenty years the company has operated a bearing factory in England jointly with a British firm, and this combination organized a French concern that has functioned steadily except during the years of enemy occupation. A Canadian factory was established in 1946.

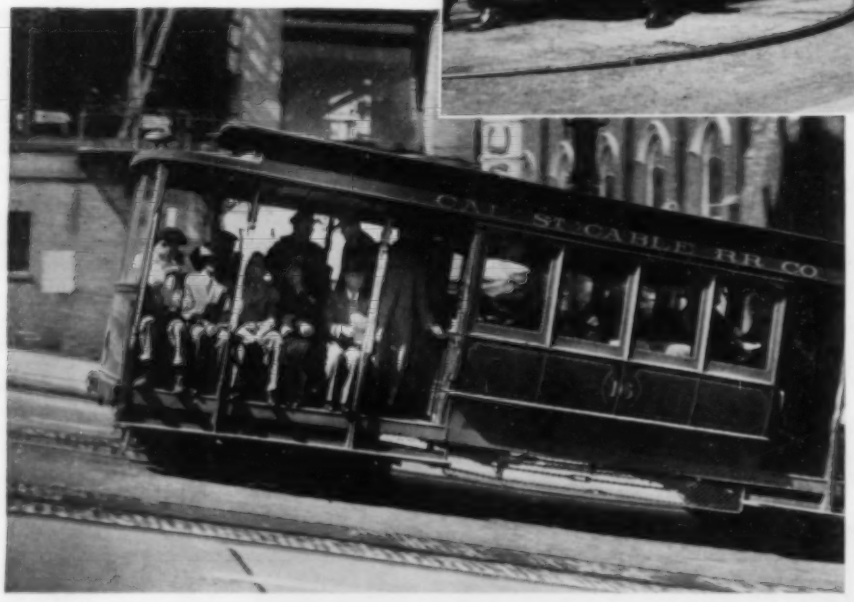
MODERN ACTIVITIES

When Timken modernized its steel rolling mill in 1928-29, roller bearings were used throughout, both in tried and untried applications. Much of the company's subsequent steel-mill bearing business resulted from the first-hand experience thus gained. The great size of some of the bearings is apparent in the view below, where they are shown undergoing final inspection. On a polished table that deviates only one twenty-thousandth of an inch from absolute flatness, the inspector, lower-right, measures the length of a bearing cone assembly. Pictured also are taper masters and gauges. Equipment for controlling the accuracy of bearings within extremely fine limits is checked in a laboratory that is kept at a uniform temperature of 70°F. to eliminate expansion and contraction. The original Burlington streamlined Zephyr (bottom-left), that went into service in 1934 on an unprecedented speed schedule of more than 60 miles an hour on the Chicago-Denver run, was equipped throughout with Timken-bearing axles to reduce friction and thwart "hot boxes."



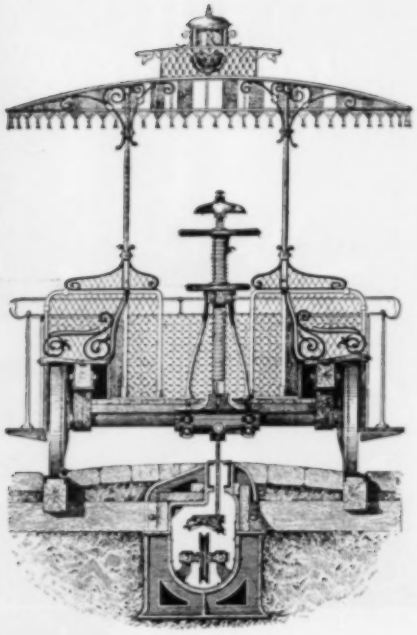
San Francisco Parts with More Street Cars

L. A. Luther



SURVIVING CABLE CARS

San Francisco still clings proudly to its two remaining cable-car systems. The conductor with his back to the car pictured at the top is shoving it off the turntable which has reversed it at Powell and Market streets for the return run over Nob Hill on Powell. The lower view shows a car of the privately owned California Street Line descending a hill.



CABLE-CAR PRINCIPLE

Sectional sketch of the first cable-car system, the Clay Street Hill Railroad in San Francisco, planned by Andrew S. Hallidie and built in 1873. At the lower end of the vertical bar extending from the undercarriage through a slot in the street surface are grippers that seized the moving cable, which rode on sheaves and was driven by a stationary steam engine. Note that the rails were straps of metal on wooden stringers. Appleton's "Cyclopaedia of Applied Mechanics" (1892 edition), from which the illustration is taken, states that cable cars could be stopped more readily than horsecars and therefore were less liable to cause accidents.

FOUR streetcar tracks running the length of downtown Market Street in San Francisco, Calif., have long been a cause of wonder to visitors. Crossing the wide thoroughfare in an automobile has been difficult for those unfamiliar with that section of the city because Market is intersected by many side streets in which turns are restricted. Automotive traffic on this famous old thoroughfare has played the role of a stepchild, for it is confined to a single lane along each curb. This instance of a fine, wide boulevard on which hoary old streetcars have been cocks of the walk may be attributed to sentiment or tradition.

In 1860 the trains of the San Francisco & San Jose Railroad sometimes used the streetcar tracks to come as far as the site of the present Palace Hotel, the locomotive being preceded by a man on horseback ringing a bell and shouting, "Look out for the train!" In those days the rails on Market ran through cuts in sand hills that were so narrow and deep that the tracks were often covered with drifting sand. Between California and Third streets the elevation was so low as to create a water hazard in wet weather. But even so, the rails offered a much more uniform surface than the street, with the result that carriage and wagon drivers tried to follow them. To discourage this practice on the part of private vehicles, the railroad company excavated deep trenches underneath and across the tracks.

Never noted especially for the breadth, smoothness, and uniform grade of its streets, San Francisco found horse-drawn streetcars indispensable in negotiating the alternating swamps, sand dunes, filled ground, and high hills in which it took root. By 1873 there were eight separate lines in operation that enabled one to visit the Cliff House and watch clipper ships pass through the Golden Gate, or to go shopping downtown or perhaps explore new residential subdivisions among the dunes south of Van Ness Avenue. New railway em-

ployees sometimes became confused amid the maze of rails and switches and, unless smart enough to "give the horse his head," had to be rescued from wrong tracks.

Public regard for the gaily painted and lettered vehicles produced some strange and wonderful creations such as a balloon car embodying a built-in turntable by which it could be swung around at the end of the line for the return trip. There was also a palace car for ladies only with velvet carpet, sofas along the sides upholstered with sixteen-dollar-a-yard tapestry, and with two hundred dollars' worth of paintings on the walls. Needless to say, the fare on this boudoir on wheels was ten cents, not the nickel ride so dear to the hearts of San Franciscans that a group petitioned the state legislature to make it mandatory.

Perhaps a subconscious liking for street railways as such partly accounts for the efforts that are being made to prevent the discontinuance of the last two of San Francisco's cable-car systems. One, the California Street Line, is privately owned. There was at one time more than 200 miles of trackage on which cars were propelled by humming cables running on sheaves beneath central slots. Leland Stanford built the California Line to provide safe transportation up the alpine slopes of Nob Hill, where his mansion stood just below the present site of the Mark Hopkins Hotel, and to demonstrate that he could construct a cable line that would be superior to those then in existence. (It did weather the 1906 quake better than most.) Stanford was just as proud of his street railway as he had been of his Central Pacific Railroad.

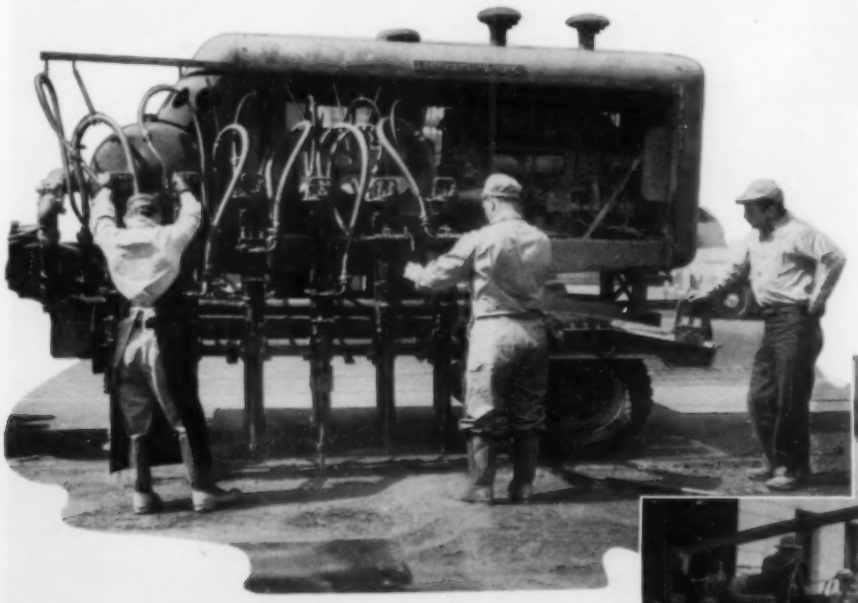
Sentiment as to the small cable cars is divided. Those opposed to them will tell you that they aren't worth keeping; that they're a good 75 years old and they're made-over horse cars anyway. Those not in favor of abandoning them for faster-moving buses—and the number includes a host of San Franciscans, as well as visitors—insist that they are an invaluable tourist attraction and should not be destroyed. Certainly, out-of-town passengers on the ancient vehicles, with their hand-wrought woodwork that is reminiscent of Concord coaches, ride them with something of the spirit of adventure.

Ordinary streetcar trackage in the city, however, is fast disappearing. Just now San Francisco has more barricades and detours than ever before; and even on Market, where the streetcar made its first appearance, sections of the two outer tracks are being ripped up. Several contracts covering rail removal have been let, including trackage on many principal thoroughfares that will be served by buses.

Men excavating at an old Market Street Railway car barn recently turned up a whole underground switchyard of horsecar rail—a strip of flat metal, not very thick, provided with a shallow flange and with countersunk holes for spikes by which it was secured to longitudinal wood stringers. Those tracks may have offered a bumpy and insecure riding surface, but they were at least easy to take up. Most of those now being removed consist of girder rails fastened to redwood ties, all embedded in concrete.

To prevent the destruction of more paving than necessary, the Lowrie Paving Company is line drilling the concrete along each side of the track and at other points where a definite shear line is to be established. To do this, a battery of J50 Jackhamers is mounted in drifter-type shells equipped with automatic power feed and spaced at 12-inch intervals on a bar attached to the frame of a highway trailer carrying a 500-cfm. portable compressor. A truck moves the trailer on the track, and the holes are drilled on 6-inch centers. Dry drills with Jackbits are used, the latter having center and side holes.

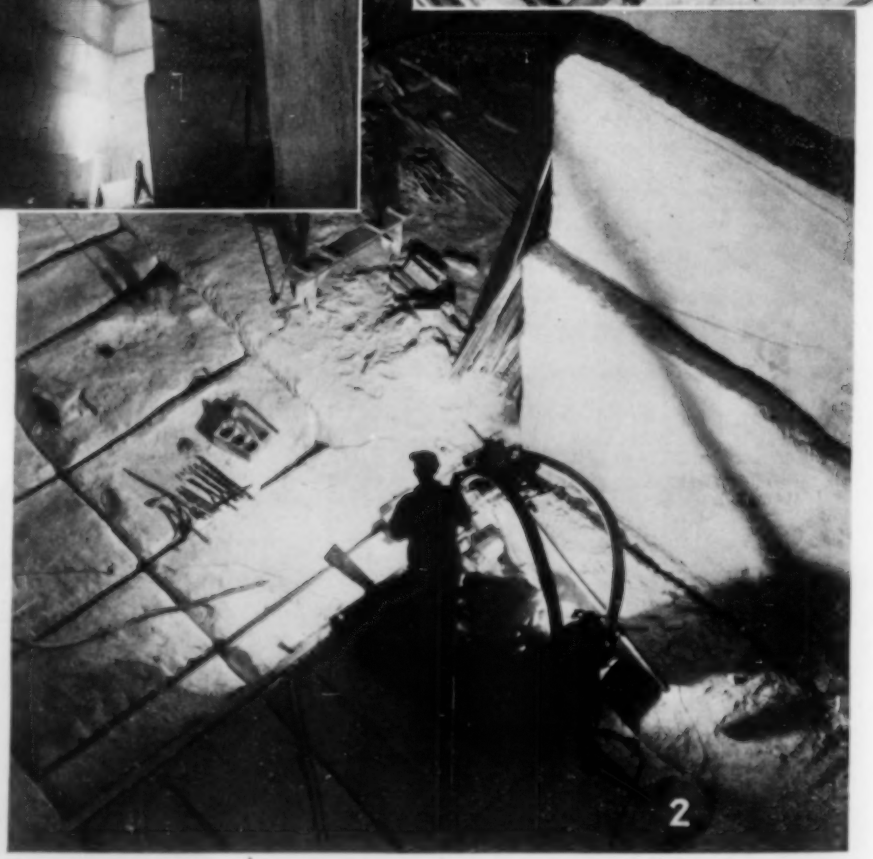
Paving is broken away from the head of each rail at intervals to provide a grip for extra-heavy tongs attached to a front-end loader mounted on a caterpillar. But before a rail is yanked up, a paving breaker with a chisel steel cuts through the blacktop surfacing between the drilled holes because that material tends to tear and shear unevenly. In the process of pulling it free from its hold, the rail breaks up the concrete and is then cut into suitable lengths for loading on trucks. Accuracy of alignment and spacing of holes possible by the line-drilling method is enabling the contractor to do the work much better and at far less cost than it could be done by hand-held drills.

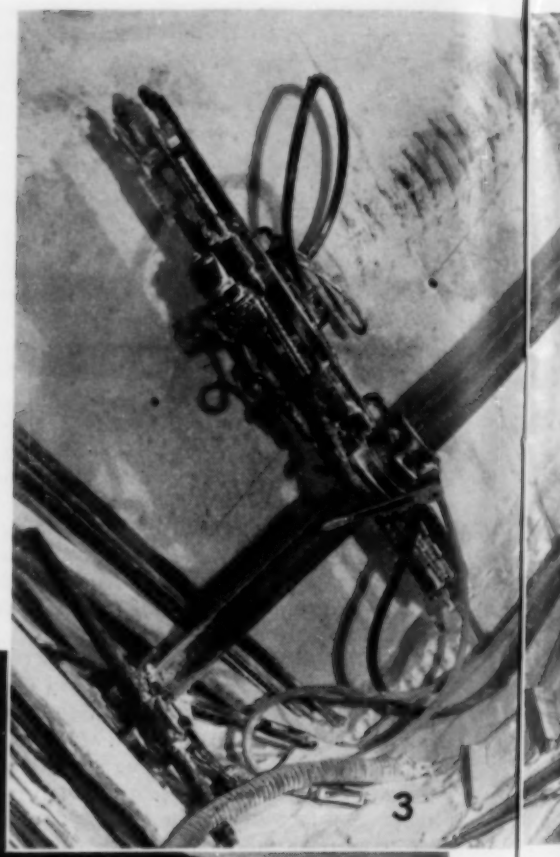


TEARING UP OLD TRACKS

The rig pictured above is used by the Lowrie Paving Company to line drill the pavement on each side of the tracks that are to be removed and thus establish a clean-breaking line. Six J50 Jackhamers, spaced a foot apart, are mounted on a bar on the side of a highway trailer, which also carries a 500-cfm. Mobilair compressor. The two shear lines can be seen in the other view, which shows the tongs, suspended from a front-end loader, ripping up a rail.

Glimpses of the Marble Industry





SINCE the days of early Greek and Roman civilizations marble has been a favored stone for architectural and ornamental purposes. Many of Athens' famous structures were built of it; and Michelangelo and other masters, by carving their finest sculptures out of that material, set a fashion that still endures. Much European marble has been imported to this country, but we have quarries of our own that produce high-quality stone.

Marble is used mostly in large permanent public edifices and for memorials, and its production fluctuates widely with changing trends in economic conditions. Demand for it was low during the depression and war years but has increased greatly as a result of postwar building expansion. Our principal quarries are in Vermont, Georgia, and Tennessee, but a dozen other states contribute small quantities.

Among individual concerns, Vermont Marble Company is the leader. Its history goes back 80 years, and during virtually all of that period it has been directed by a member of the Proctor family, which has meanwhile also furnished Vermont with four governors. In turn, the chair was occupied by the company's first president, Redfield Proctor, Sr.; his two sons, Fletcher D. and Redfield, Jr.; and lastly by his grandson, Mortimer. Redfield, Jr., is now president of the concern and Mortimer is vice-president.

To fortify itself against economic vicissitudes, Vermont Marble Company has scattered its interests throughout the country and has conducted research to find additional uses for its stone. Even the most careful quarrying and finishing

PHOTOS, THREE LIONS, INC.

1 CAVERNOUS QUARRY. Stone of a certain type or color is often followed downward by a combination of vertical and horizontal workings that result in several levels and huge underground openings. Picture No. 2 shows the horizontal passage from which this chamber was developed.

2 PATTERN OF RECTANGLES. An electric-air channeling machine, running slowly back and forth on movable tracks laid on the floor cuts parallel grooves in the marble about an inch wide and 5 or 6 feet deep. It is then run at right angles to the grooves, cutting others to form a pattern of rectangular blocks that are extracted and hoisted to the surface.

3 DRILLING ON THE BIAS. To quarry stone from a sloping bed, a DA-35 drifter drill is adapted to serve as a broaching machine. From its mounting on a 5½-inch bar it drills a line of closely spaced holes. The intermediate sections are then cut away to form a continuous channel. The machine is shown working on a 52° incline.

4 RUBBING BED. After being hoisted above ground, quarried blocks are sawed into pieces sized according to their intended uses. The latter are then finished by subjecting them to one or more treatments. A slab designed for decorative purposes is shown here being held by a vise against the surface of a large, revolving, iron turntable, where its contacting face is rubbed smooth with sand and water.

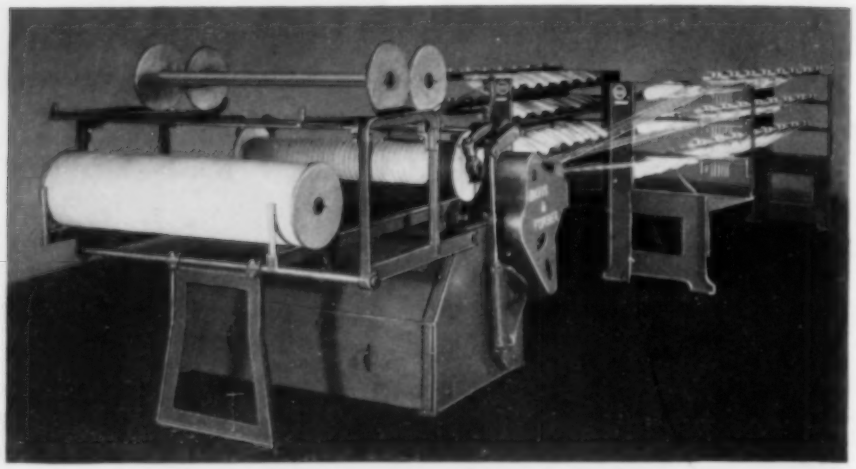
5 FINISHING A STATUE. Using small, high-speed pneumatic hammers, skilled artisans turn out artistic objects in a fraction of the time formerly required with hand hammers and chisels. They can also do finer and more accurate work. The picture shows a statue, patterned after the small model beside it, receiving finishing touches.

methods inevitably produce huge amounts of fragments, which formerly were largely wasted. Chips, when reduced in size, now enter into the manufacture of terrazzo flooring, and some are pulverized to serve as fillers in plastics, asbestos shingles, and even chewing gum.

Vermont Marble Company is now extracting from its West Rutland quarry approximately 100 carloads of white Vermont Pearl stone for the Secretariat Building of the United Nations headquarters, which is being erected in New York City. Cut into thin slabs measuring 2x3½ feet, it will be used to face the exterior of the two end walls of the 39-story structure. The sides will be of glass.

Most of Vermont's marble quarries are in reality mines because their workings are now largely underground, and some have a number of operating levels. Air-powered rock drills and associate equipment are essential tools in hewing out the huge blocks of stone that are hoisted to the surface and then sent to mills to be sawed into smaller pieces that are finished in accordance with their intended uses. Smaller pneumatic hammers are employed by the artisans who fashion marble into varied ornaments and works of art. The accompanying pictures show a few of the steps by which the stone is quarried, processed, and converted into a statue.

Compressed Air Aids Textile Mills



ELECTROPNEUMATIC SPOOLER

This machine simultaneously rewinds yarn from 48 small bobbins onto one large bobbin or spool, thereby saving much time in prelooming operations. A full spool is shown at the left, while just beyond it another is being wound. Below it, on the right side of the machine, is a pneumatic cylinder which, through a roller-and-arm attachment, controls the winding tension. This reduces yarn breakage and insures a compactly wound spool.

MAKERS of textile machinery, like manufacturers of other industrial equipment, have not hesitated to turn to compressed air where that form of power could be used to advantage. In several instances, the addition of pneumatic devices to existing machines and their incorporation in new ones have resulted in equipment superior in performance and output to those lacking these improvements. A few such machines are described in this article.

In the manufacture of woolen cloth, yarns emerge from the spinning frame on bobbins that hold anywhere from 2 ounces to a pound or more each. But before the yarn goes to the loom, the bobbins, or "packages" as they are called, must be rewound, a number of them being reeled simultaneously on a single large spool that provides the warp threads of the fabric to be woven.

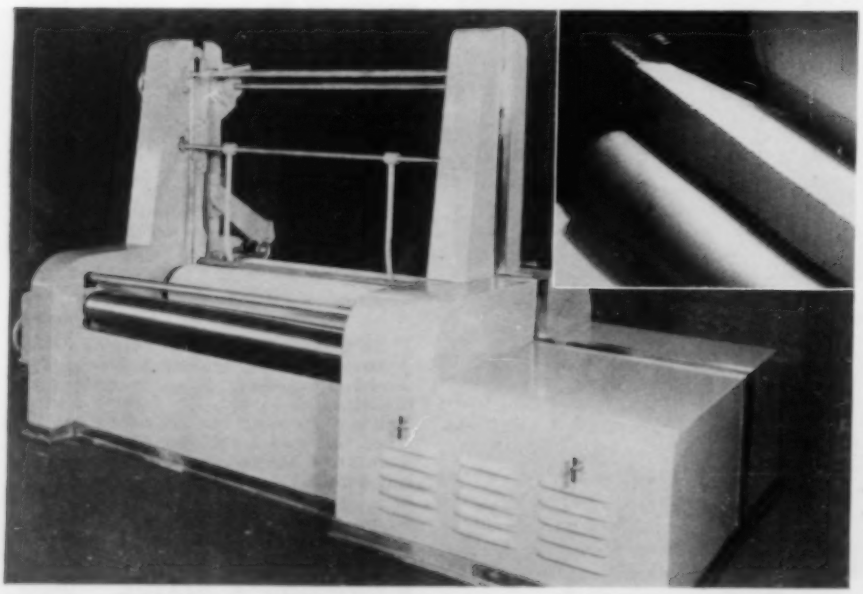
To take advantage of the higher spooling speeds possible with modern large-sized bobbins, Davis & Furber Machine Company of North Andover, Mass., recently introduced an electropneumatic warp spooler for woolen yarns. Known as the Model 60, it has many automatic and semiautomatic features that are intended to provide more positive spooling control and to reduce the amount of manual labor ordinarily required.

The magazine creel of the machine is made in two sections or banks that are spaced far enough apart for an operator to work between. Each section holds 48 yarn packages. Twenty-four of these are "live ends," so called because one end of each is connected to the spool of the winder. The remaining 24 are reserve bobbins the ends of which are tied in tandem to the tails of the live ends.

The yarn from each package in the creel travels to a front-thread guide on the spooler, then around a measuring roll driven by a variable-speed V-belt pulley through which the tension on the thread is adjusted and maintained, and finally to the spool itself. The rate of movement can be varied from 275 to 550 yards a minute by means of a rheostatic control on the machine's 1½-hp. driving motor. A braking device built into the latter can bring the spooler to a stop quickly and smoothly from a speed of 500 rpm. within approximately 2 yards of thread travel.

Two electronic stops are embodied in the machine and control the braking action of the motor. One, located on the creel, eliminates much rethreading of broken ends because the machine is brought to a standstill before the ends reach the spool. The other, which is between the measuring roll and the spool, catches any break that may occur after the yarn has passed the first stop. These sensitive mechanisms will immediately halt the spooler when any thread becomes slack.

At the point where the yarn comes in contact with the spool, pressure is applied to both by a roller-and-arm arrangement actuated by an air cylinder mounted underneath the spool. The



PNEUMATIC CUTOFF WINDER

This streamlined machine cuts the continuous cloth strip when a roll has been filled and automatically starts winding another. It saves the refinishing of upwards of 50 yards of goods that becomes soiled, oversteamed, or overdried when work is stopped to perform these operations. The inset view shows the toothed knife about to cut the cloth being wound on to the roll above it. Below the knife is a shell around which another roll will be started.

pressure can be varied to meet requirements by regulating an air gauge and is kept constant by a safety valve. By maintaining the desired tension, this pneumatic feature, according to the manufacturer, permits winding up to 40 percent more of certain kinds of yarn. In addition, noise and vibration are greatly reduced because the spool "rides" on a cushion of air.

A semiautomatic spool rack eliminates heavy lifting in changing spools. By turning a lever, the operator actuates a pneumatic mechanism that lifts the full spool off the drum and deposits it in the rack that holds three spools. At the same time, an empty is automatically fed to the drum from a loading magazine above the rack, and the machine is ready to run again. Space is available in the magazine for three empty spools.

An air-operated cutoff winder, manufactured by H. W. Butterworth & Sons Company, Philadelphia, Pa., is designed for use in textile mills that turn out piece goods for the trade. The cloth is bleached, dyed, and then finished by passing it continuously through various chemical and steam processes during the course of which it has to be rolled and cut so that it can be properly handled and prepared for the next step. Embodying a pneumatic cutoff and an automatic slitter, the winding machine cuts the material when one roll is finished and starts a new one, all in one automatic operation. It is built in standard sizes capable of accommodating rolls from 50 to 72 inches wide and in special units for other widths. The frame and controls are completely enclosed in a streamlined housing.

The action of the winder begins by starting off the fabric on a wooden shell mounted between two rolls and having a center bar that is held at each end by pairs of mechanical jaws. Contact with the revolving drum at the back of the machine keeps the shell turning, and as the roll of cloth increases in size it rises, the jaws moving with it. At an established point the lower set stops rising and the rotating roll is held against the drum by the pressure of its own weight. When there is a space of 2-3 inches between the upper and the lower jaws, a rack is automatically raised and a pawl engages the notched flanges of the jaws, holding them apart. The roll is now in contact with both the front and the back drum.

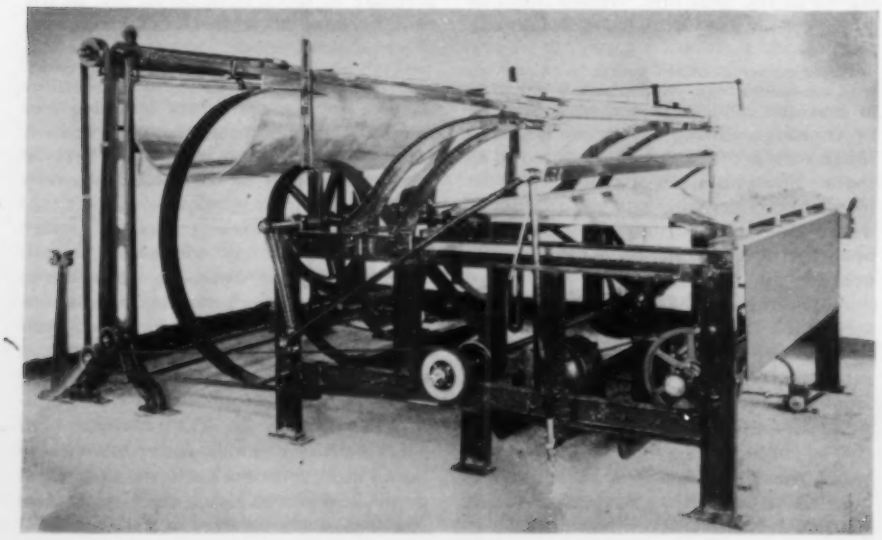
Before the roll has reached full size it is automatically shifted to the delivery end of the machine, where it continues to turn. A second wooden shell is then put in the lower jaws. The operator now watches the moving material for a seam, and as he sees one approaching pulls a control lever, causing a pneumatically powered shearing knife to cut the cloth. Simultaneously, the new end is dampened by jets of water that issue from a special pipe between the drums, and curved mechanical "fingers" place it around the shell. The damp fabric sticks to it and a new roll begins to form.

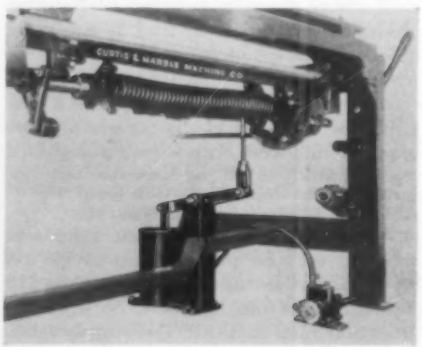
Winding thus proceeds without loss of time, a feature that results, it is claimed, in saving upwards of 50 yards, the amount normally spoiled under ordinary methods of rolling and cutting because it becomes soiled, oversteamed, or overdried when work is stopped to permit cutting and starting another roll. When one is nearly finished, the operator exerts slight upward pressure on a control lever, causing a mechanical pusher to lift the roll into the jaws of two hinged arms where it remains while winding is completed and until the operator finds time to remove it.

Curtis & Marble Machine Company, Worcester, Mass., makes an air-operated device for use on cloth-folding machines that put folds at equidistant points, usually one yard apart, in both unfinished and finished or bleached goods. The machines are generally of the spring-controlled type worked by pawls, ratchets, etc., and have a table that must be raised to the proper position when folding commences and lowered progressively as the material piles up. Known as the Lewis Air Lift or Pneumatic Table Lift, it does pneumatically what the operator otherwise has to do by means of a foot treadle. Because it greatly lightens the work, the device was utilized extensively during the war when women were called upon to replace men in the mills.

The lift is essentially a 5-inch-diameter air cylinder. It is controlled by a foot valve and is supplied with air at 35-50 psi. either by a shop line such as is found in many mills and finishing plants or by an individual compressor. When the valve is opened, the cylinder piston rises, pushing up one end of a pivoted rocker arm to which it is attached. The other end of the arm moves downward, raising the table through a mechanical interconnection that is a part of the folding machine. When the cloth has been folded, pressure is released and the table descends.

The Lewis Air Lift was designed solely for and is applicable only to spring-operated folding machines used by the textile industry. The company also manufactures a unit that is powered entirely by compressed air at 25-30 psi. In this case, air serves not only to raise and lower the table but also to support it directly while the material is being folded and to help operate the folding mechanism.





FACILITATES FOLDING

An air-operated cloth-folding machine built by Curtis & Marble Machine Company is shown at the left. The concern also makes the Lewis Air Lift (above) which can be attached to older-model folding machines to raise and lower the table on which the folding is done. It was widely used during World War II to replace foot-treadle lifts that could be operated only with difficulty by the women workers who supplanted men in textile mills.

Scouring a Building with Sand

GENERAL AND NEAR VIEWS

Approximately 7000 square feet of wall area was covered in removing paint from the 52-foot-high, 125-foot-long building preparatory to stuccoing the added fifth floor and the lower section to give the structure a uniform appearance. The blaster worked on movable scaffolding while his helper on the ground regulated the supplies of sand, compressed air, and water. The close view shows the water jet, just above the blasting nozzle, which served to keep down dust and, later, to wash the wall so as to clean it and reveal any areas that might need more blasting.

BACK in 1908, an eastern manufacturer erected a 2-story concrete office building for use in connection with a growing plant. Five years later two floors were added, and in 1930 the structure was further enlarged by a 4-story wing. But as business continued to increase, the quarters again became too small and it was decided to modernize the building and to add a fifth floor.

Part of this project calls for a new exterior finish of white oriental stucco. To obtain a permanent bond between the old concrete walls and the new coating it was necessary to remove paint, which was found to be seven layers thick on the oldest part of the structure. The work was done by sandblasting in vertical strips from a tubular scaffolding mounted on wheels so that it could be quickly moved along. Windows and frames in the immediate vicinity of the operations were protected against flying particles of abrasive by sheets of plywood, which were transferred along with the scaffolding so as not to cut off natural light and ventilation from the offices any longer than necessary.

A pure silica Grade No. 1 sand was selected for the job because of its extreme hardness and sharpness and had to be obtained from Millville, N. J., more than 300 miles distant. The supply tank, at ground level, had a capacity of 700 pounds of the abrasive material, which was applied with air at 100 psi. pressure through a 1-inch (inside diameter) hose and a ¼-inch steel nozzle that was held about 6 inches from the wall.

A small stream of water issuing from a jet directly over the nozzle served to minimize the sand and paint mist. By turning a hand valve, the sandblaster was able to increase the volume of the flow so as to wash the treated surface as soon as he had removed all the paint within his reach. This practice also enabled him to examine the area and to go over any spots, if necessary, before moving on to the next one. While this was going on no sand was fed through the hose.

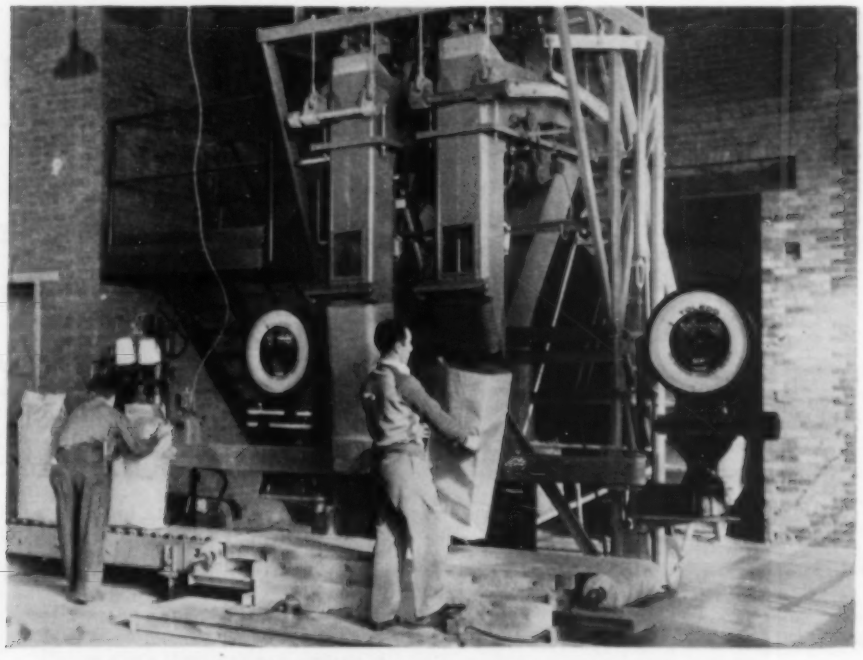
After removal of the paint the building was washed down with a weak solution of muriatic acid, and this was followed by thorough rinsing with clear water to rid the walls of the fine dust clinging to them. The admixture of sand and air for most effective cutting and the amount of water used were regulated by the relief operator at the controls on the supply tank.

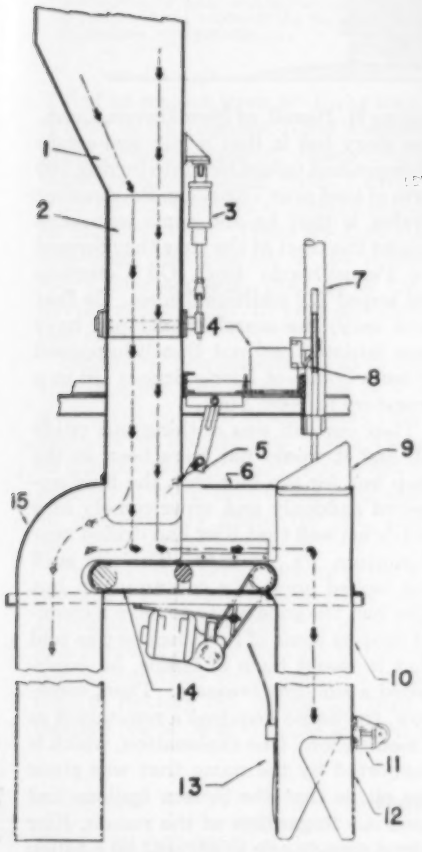
An average of 200 square feet of surface of the 7000 square feet involved was cleaned per day, and about 9 pounds of sand was required to remove the paint from one square foot. Working at this rate, the hopper tank had to be refilled two or three times a day. Only new material was applied, for it was found to cost less to buy it than to reclaim the old. The abrasive action of the sand is attested to by the fact that wear necessitated nozzle replacement every three or four hours. This was indicated when it was no longer possible to maintain a pressure of more than 80-85 psi. in the tank because of the increase in diameter of the nozzle orifice.

With his head encased in a helmet, the sandblast operator was supplied continuously with approximately 15 cubic feet of fresh air per minute through a ⅜-inch hose. The headpiece was of the type in which the flow is directed downward across a 4x6-inch window so that it will also prevent the glass, protected against breakage by a fine wire-mesh screen, from fogging or steaming up and obscuring the worker's vision. A moisture trap at the hopper tank removed condensate from the air line leading to the helmet.

The contractor on the job was Tankline of Corning, N. Y., a concern that specializes in cleaning water towers and liquid storage tanks both above and underground and in giving them protective coatings.

Automatic Packaging Machine for Rock Wool





FLOW DIAGRAM AND MACHINE IN USE

The automatic rock-wool packaging machine is of twin construction to permit continuous operation. The worker at the right is slipping a heavy paper bag over the duckbill that is expanded, as the left hopper shows, to hold it firmly in place and to form an airtight seal to prevent the escape of dust while it is being filled. Air pressure is used to operate the duckbill and is controlled by a foot valve. Before the bag is released, the rock wool is compacted lightly by a pneumatic ram to a fixed load line. The container is then lowered on to a traveling conveyor that carries it to a machine (left) that sews it shut. The numerals on the flow diagram indicate: 1, delivery manifold; 2, diverter; 3, diverter cylinder; 4, air valve; 5, air jet; 6, conveyor cover; 7, ram cylinder; 8, ram reversing switch; 9, ram; 10, hopper; 11, duckbill adjusting mechanism; 12, duckbill; 13, bag indicator; 14, feed conveyor; 15, exhaust manifold.

INSULATING new as well as old homes with rock wool to keep out heat in summer and cold in winter has become fairly common practice. The noninflammable material comes packed in bags from which a truck-mounted blower shoots it directly into place through large-diameter hose. Application of the light, fluffy material offers no difficulties; but the way in which the bags are generally filled at the point of production is unsatisfactory on two counts: it creates dust, which endangers the health of the workers, and it is not possible to provide packages of uniform weight.

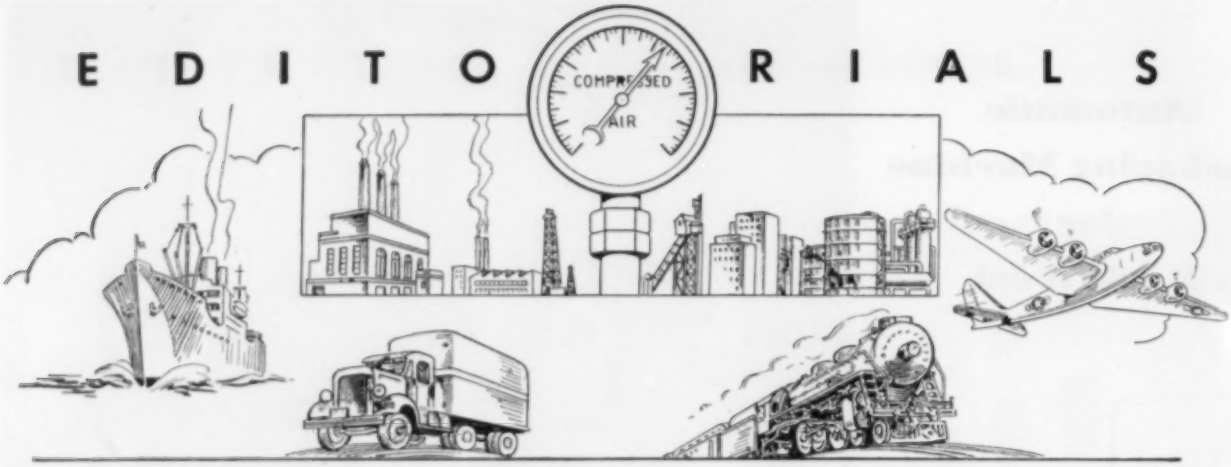
These problems have been overcome, it is reported, by a packaging machine that is now in use in the plant of the National Gypsum Company for which it was designed by the Union Bag & Paper Corporation. It is electrically controlled, and two men are required to handle the bags at the discharge end. Granulated rock wool contained in multiple cupolas is fed alternately on to two enclosed conveyors, each of which is mounted on a weighing mechanism with adjustable scales. Variable quantities ranging from 25 to 100 pounds are measured out with accuracy, the standard package being 40 pounds.

At the end of each conveyor is a vertical hopper with an air-operated duck bill at the bottom. This serves to expand the bag, which forms the bottom of the hopper, holding it open to receive the rock wool and also providing an airtight closure that prevents the escape of dust. When all the material has been transferred to the bag, the scale dial actuates a diverter in the feeder spout, thus shifting the flow to the other half of the system and permitting the machine to work uninterruptedly. This switchover is effected with the aid of a blast of air that, like a knife, cuts off the descending column of rock wool. A time switch functions simultaneously, causing the active conveyor to travel its full length and to dump its load into the associate hopper for packaging, as just described.

As soon as the time switch has completed its cycle, a pneumatic ram moves down into the hopper, compacting the insulating material to a fixed load line. This is important, because too much pressure on rock wool reduces its coverage area, which is approximately 40 square feet in the case of a 40-pound bag. It is claimed that controlled compression results in the use of fewer bags than normally, with appreciable savings, and that accurate measurement effects further reductions in cost by eliminating overweight. The bags are made of multiwall kraft paper and are uniformly rectilinear in shape. Because of this, they can be readily palletized and occupy approximately 10 percent less space in storage and in transit than the ordinary kind.

The machine functions automatically and is ready for service when connected to sources of compressed air and electricity. It is built of structural steel throughout, and its electric controls are mounted on one side in a dustproof box. In fact, the entire equipment is so well enclosed that the atmosphere is not contaminated with dust, unlike that in most plants where rock wool is packaged. In the event of functional difficulty or bag trouble, the flow is diverted back into the hopper. Though designed primarily for handling rock wool, it may be used to advantage in packaging asbestos fibers, beet-sugar pulp, soybean pomace, and other materials that have similar characteristics.

EDITORIALS



SPUR FOR ROCK DRILLS

WRITING interestingly of the history of explosives in the July issue of *Nation's Business*, George Scullin poses the question, "Did we grow up or blow up?" Incidentally, while he does not mention rock drills, he indicates why the mechanical drill was bound to come along about when it did.

Tracing the development of explosives from the discovery of gunpowder by Roger Bacon around 1285 to such modern high-pressure concoctions as TNT, the writer makes the point that dynamite was one of the most potent influences in the upbuilding of the United States as we know it. For it was on these shores that explosives were first put to large-scale use in constructing railroads and canals, in clearing land, and in opening up the country generally.

For 300 years following its introduction, gunpowder was employed almost exclusively in waging war. Its application in mining dates from 1627 in Germany and 1689 in England. The discovery of nitroglycerine in 1846 by Sobrero, and its subsequent conversion into dynamite by Nobel, gave the mining and construction industries their first really effective explosive for breaking rock. Dynamite was initially made in the United States at San Francisco in 1868.

It was inevitable that inventive minds, in order to use this new substance to greatest advantage, should turn their efforts towards developing a way by which blast holes could be put in faster than by the prevailing hammer-and-chisel method. Undoubtedly something more than coincidence accounted for the advent of the mechanical drill coevally with nitroglycerine and dynamite. Couch's drill appeared on the scene in 1849 and was followed successively by the creations of Fowle, Burleigh, Ingersoll, and others.

According to Mr. Scullin, the production of dynamite in the United States approximates 250,000 tons a year, and of this all but about 4 percent is consumed in the mining and construction fields. In view of the fact that in both industries holes must be drilled in which to place the explosive, the importance of the rock drill is obvious.

A LUSTY NONAGENARIAN

PETROLEUM and its myriads of derivatives are so much a part of our everyday lives that it is hard to realize that mankind has had the benefit of their services for less than a century. Actually, August 27 will mark the ninetieth anniversary of the birth of the petroleum industry. Until then, the meager supply of the deep-brown smelly substance, without which our modern economy would bog down, was ground seepage.

Although there is evidence that ancient peoples made limited use of natural-petroleum residues such as pitch and asphaltum for calking boats and other purposes, no one apparently suspected that hidden in the hydrocarbon molecules of petroleum itself was power enough to turn the wheels of the world and of lubricating them, as well. The alchemists who sought long and unsuccessfully to transmute base metals into gold little dreamed that the earth's crust harbored enormous reservoirs of fluid treasure that were destined to build far bigger fortunes than all the precious metals, speed the progress of civilization, and decide the outcome of global wars.

Looking back on that scene in Western Pennsylvania in August, 1859, when "Drake's Folly" paid off, it is obvious that even the principal actors in the drama did not envision the true value of the material for which they were probing. Drake's venture was the result of a peculiar set of circumstances. In the first place, Drake was a retired railroad conductor not a driller, and it is difficult to perceive just why he was chosen to direct the operations. The technical know-how was, of course, furnished by W. A. (Uncle Billy) Smith and his two sons, who were experienced drillers of salt-brine wells.

The promoter of the search was George H. Bissell, of New Haven, Conn. One story has it that a glib real-estate salesman had talked him into buying 100 acres of land near Titusville, Pa. Another version is that he and some associates bought the tract at the time they formed the Pennsylvania Rock Oil Company and leased 112 additional acres. Be that as it may, the search would not have been initiated had not Bissell happened to see a bottle of Kier's Seneca Oil in a drugstore in New York.

That cure-all was nothing but crude oil, and it would not have been in the shop but for the fact that the fluid appeared suddenly and unwelcomely in a salt-brine well that Kier had drilled near Tarantum, Pa., in 1849. The oily stuff was looked upon as a contaminant, but Kier had the good sense to have a chemist analyze some of it. When he was told that it would burn in lamps, he established a side-line business. Then, somehow, the liquid acquired a reputation as a medication. One explanation, which is supported by the name that was given the oil, is that the Seneca Indians had used it. Regardless of the reason, Kier found a ready sale at $1 to $1.50 a gallon for all he could supply.

Being inquisitive and not averse to making money, Bissell investigated the Seneca Oil and determined to launch a similar enterprise. Thereupon he organized his company, engaged Drake, and set to work. He was not immediately successful; in fact, Drake and Smith toiled for more than fifteen months before the tools of the cable drilling rig struck oil at a depth of less than 70 feet. In this pioneer venture, Bissell set a pattern that is still followed by the oil industry. He showed a willingness to gamble, and he was persevering. Even the largest producing companies are still cashing in by following his example.

The first production from Drake's well was sold to Kier and found its way to other drugstore shelves. It was not long, however, before petroleum began to find its real place in the world. Since then the industry, nurtured by Drake's Folly, has grown by leaps and bounds

Life with an Impact Wrench

EDITOR'S NOTE: The material that follows appeared in the *Robinson Refiner*, employee publication of the Ohio Oil Company's Robinson, Ill., refinery. It was written by the toolroom foreman. Although the performance figures he gives present an impressive story of the work the pneumatic impact wrench does, they should be increased by about 62 percent because the Size 555 tool concerned strikes 1100 blows per minute instead of the 680 cited. On this revised basis, the total blows for the year would be 4,928,000. It is interesting to note that even though the wrench is in service only 72 hours a year, or nine 8-hour shifts, it is obviously a time- and money-saver, for it would not have replaced the hand-operated equipment used previously.

I AM an impact wrench. I was born in 1937 in an Ingersoll-Rand Company plant. Since an impact wrench reaches maturity shortly after birth, I came to work for the Ohio Oil Company refinery on May 27, 1938. There are four other employees just like me in the refinery, but I have seniority over all of them, having received my 10-year service pin last year.

Naturally, you are curious as to what kind of a job I have, and I am only too glad to tell you. First, let me say that in many ways I am like you. I weigh about 60 pounds and my heart beat is 680 per minute. I work best when I am under air pressure, say about 100 psi., and I can work either backward or forward.

To give you a better picture of my job, perhaps a flash back over my last year's activities will do the trick. To start with, in my travels I made ten trips to Battery No. 3, nine trips to Battery No. 1, ten trips to Battery No. 2, and ten trips to Battery No. 4. Also, I made seven trips to the Kellogg and three to the crude still. Most generally I get to work around midnight and start pulling pins on one side of a cracking furnace while my buddies take the other.

In a cracking furnace there are about 402 tubes. I take down one side of the furnace, which, the way I figure, makes about 102 tubes. By making a total of 39 trips to the batteries I guess I have pulled 3978 pins at these units during the past year.

It generally takes me about 30 minutes to do my side. Thirty times 39 (the trips) makes 1170 minutes and, as I said, 680 is the number of strokes of my heart per minute. This gives a total of 795,600 blows on the cracking units.

I also have a small job to perform at No. 2 still which takes me about ten minutes, and I made that trip 39 times last year. So here again I got in some good licks with a total of 265,200 blows.

My job at the crude still is a toughy. Twice a year we unhead everything here. There are 596 tubes and 1192 plugs. I take about eight hours to unhead the furnace, so here again, using my little old slip stick, I find that I batted a neat 652,800.

Finally, the Kellogg was down seven times last year, and as the job takes two hours, I get this for an answer: 2 times 7 equals 14, and 14 times 60 minutes times 680 equals 571,200 more blows to add to my count.

So, with a little addition, I come to the conclusion that I have struck 2,284,800 blows. Now assuming that it takes one-third as many blows to head a unit back up as to unhead it, we take one-third of 2,284,800, which gives us 761,600. By adding this to 2,284,800 we get 3,046,400 blows per year. With all this you'll find I seldom blow my top.

Last year I cost the Ohio Oil Company $54.10 in repairs. Of this amount $37.05 was for a complete gear frame, which was the first I had had since my arrival in 1938. So, splitting this $37.05 over an estimated 10-year period I actually cost only $20.75, which is a rather small wage for the amount of work I did.

However, this salary does not tell the whole story, for I live in a nice warm bunkhouse known as the Toolroom. There are all kinds of fellow employees bunking there, so I never get very lonesome. My foreman is Charlie Metheny, and "Friday" McCammon is my overseer. Friday sees to it that my physical condition is always A-1, and in general my lot is extremely good.

Although I put in a pretty good year just past, I would not be very much surprised if the next few years would be even better, what with all the new units to be taken care of.

Domestic Substitute for Foreign Palm Oil

DEVELOPMENT of a synthetic substitute for palm oil, in which research scientists have been engaged for a number of years, has reached a stage that justifies optimism as to the final outcome, according to a report recently submitted by the investigators to the American Iron & Steel Institute, the leading sponsor of the project. Palm oil has a number of important uses, including the making of hot-dip tinplate. By this method, sheets of steel are pickled in a dilute solution of sulphuric acid and passed through a flux into a bath of molten tin. From there they go through rolls in a bath of hot palm oil which spreads the tin evenly. Its use in the industry is said to date back 200 years, and in all that time it has been the only known material that would do the job satisfactorily.

Palm oil is imported from North Africa and the East Indies, and consumption in the United States for making tinplate has amounted to about 7500 tons annually. Threatened shortages during World War II and an increase in price from eight to as much as 40 cents a pound led to the present efforts to find a low-cost substitute that would make us independent of foreign sources of supply.

Dimerized linoleic or dimer acid, of which large quantities have become available only recently, has been selected from a large number of possible materials as the one coming closest to possessing the desired characteristics. These are manifold, as the following list shows. To function properly, the oil must drain rapidly and freely; have low volatility; have high flash and fire points; must not oxidize or polymerize readily; possess low viscosity to permit pouring or pumping freely; clean readily from the sheets; and should make smooth, bright tinplate. Further, it must be nontoxic; devoid of odor; should not become rancid during storage; should not interfere with lithographing, lacquering, or soldering; and should retard atmospheric corrosion.

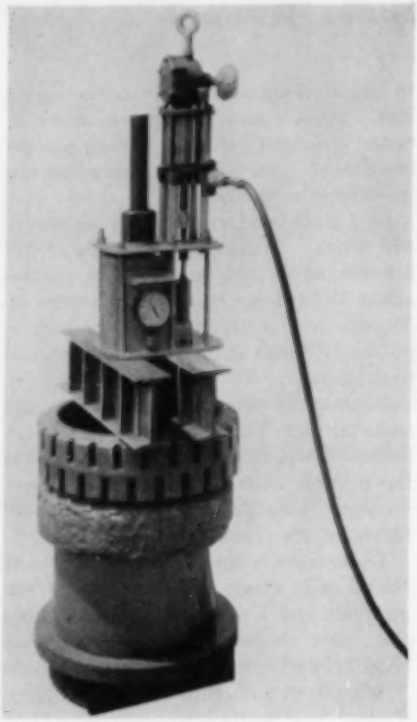
Dimer acid is the product of a common vegetable oil and is made by heating the latter under pressure in contact with steam. The residue consists of pure fatty acids and a small percentage of trimers and higher polymers. It has undergone full-scale mill-run tests in a plant of the Jones & Laughlin Steel Corporation and is said to have made a good showing. Credit for much of the progress that has been achieved so far goes to W. R. Johnson, research metallurgist; and to I. C. Kinney, supervisor of chemical engineering, and John Parks, supervisor of nonferrous metallurgy of the Chicago University Armour Research Foundation. The opinion of these scientists, as expressed in their report, is that the possibility of substituting natural-occurring Latin-American vegetable oils for imported palm oil awaits only the development of plantations and of extraction facilities.

Tire-Changing Press Features Air-Powered Jack

CHANGING solid industrial-truck tires is no longer the arduous job it used to be and has recently been further simplified by converting the Ken-Don tire press from manual to mechanical operation by means of a reciprocating air cylinder. For those who are not familiar with this equipment, which was designed primarily for industrial and service-station use, it is a portable unit with a hydraulic jack that forces the worn tire off the wheel and simultaneously pushes the new one on.

To understand how this is done, let us follow the procedure with the aid of the accompanying picture. Mounted on and centered in a hole in the base plate is a pressing band that must conform in size to the wheel. The latter, with its worn tire, is placed on the band and is followed successively by the new tire, two steel bars, and the hydraulic jack, which has a capacity of 100 tons. A threaded tension stem is then lowered through the entire set-up to engage a nut welded to the underside of the base plate. When the stem and the pressure screw of the jack have been tightened and a wing nut has been screwed to the top of the jack, the press is ready for service.

In the manual type, the jack is actuated by pumping a handle, but in the improved one it is operated by an air-cylinder unit that can be attached readily to any Ken-Don press now in use. The hydraulic jack is a Simplex-Jenny which functions just like others of its kind in lifting loads or pushing them horizontally but differs from them in that it can pull through its center hole without the need of bulky rigging or equipment. Used in conjunction with the tire press, upward tension on the pull rod exerts counterpressure which pushes the new tire on the wheel while the worn tire is being forced off.



AIR-POWERED

This picture shows the industrial tire-changing press setup ready for service. The air-cylinder unit, top-right, is controlled by a hand valve and actuates the hydraulic jack that pushes a new tire on a wheel and removes the worn one in one operation. Air at a pressure of 125 psi. is used. A 20x6x16-inch solid tire, for example, is changed in six minutes, it is claimed.

After reaching the limit of its travel—3¼ inches—the jack is returned to normal position by releasing the pressure screw. The wing nut is again turned down on the jack and the cycle repeated as often as the width of the new tire demands. It is claimed that pressing time averages one minute per cross-sectional inch of tire.

Pneumatic Can Tester

ALL tin cans before they leave the plants where they are manufactured are tested for leakage, and one of the machines used for the purpose requires no operator. Conveyed from a double seamer, they are clamped automatically against rubber disks by movable base plates. An outer airtight chamber or bucket moves over each can, which is charged with compressed air, the pressure outside and inside being equalized. If a can leaks, the pressure within the bucket increases and actuates electric contact points. Bad cans are registered by a sensitive detector and ejected by mechanical means. The tester is started and stopped by electric balance beams in the feed chute.

UNDERGROUND COAL-CRUSHING PLANT

What is reputed to be the world's largest underground coal-preparation chamber is being built by the Dravo Corporation for the Jones & Laughlin Steel Corporation at its Vesta Mines 40 miles south of Pittsburgh, Pa. Located at a depth of approximately 110 feet, the crusher room is 33½ feet wide, 52 feet long, and 78 feet from the conveyor pit to the crown of the arch roof, shown in process of construction at the left. The entire chamber extends for a distance of 340 feet and is being lined with concrete placed by pneumatic equipment. Two units are in service and are pictured at the right. Ready-mixed concrete is dropped into the hoppers of the machines from the surface through a 10-inch bore hole and is then piped to the forms by compressed air supplied by a temporary plant stationed above-ground. Each placer handles about 30 cubic yards an hour. From the crusher the coal will be carried by a belt conveyor through an 800-foot slope and across a 1000-foot suspension bridge to a new washery on the opposite side of the Monongahela River. The plant is designed to process about 2000 tons of coal an hour.

This and That

Notes on Aircraft Control

Along with the increase in size and speed of aircraft there has been a progressive development in adequate control systems. Either pneumatic or hydraulic systems serve the purpose, but it is not yet certain which one will be finally adopted. Thus far, American designers have favored hydraulic operation, while the British have inclined towards compressed air. These trends may continue, or one or the other may prove to be superior and be universally accepted. Essentially, the problem presented is that of obtaining the desired pressures without adding prohibitively to the weight and without further complicating the equipment involved.

Air pressures of 400 psi. were first used, and then there was an increase to around 600 psi. Because advantages are to be gained, chiefly in weight reduction, with still higher pressures, present efforts are aimed at reaching the 1000-3000 psi. range. Already, a 3-stage experimental compressor has been developed in England and is being tried out in actual flight. Until now it has been necessary to carry a considerable reserve supply of air in storage bottles. With 3000-psi. compressors in service, much of this storage could be eliminated. Higher pressures would also permit the use of smaller and lighter pipes, cylinders, etc., than those now commonly installed and increase the system's operating speed.

* * *

Lost Mine Cause of Concern

Arizona authorities are concerned over the latest revival of the "Lost Dutchman Mine" story. Map sellers are active again, as is evidenced by a fresh flood of letters from buyers in various parts of the country. The usual tenor of these communications is that the writer has acquired directions for reaching the gold deposit and wants advice on outfitting a proposed searching expedition. The Phoenix Chamber of Commerce seeks to turn back these unwary treasure seekers by informing them that the Superstition Mountains, where the mine is supposed to be, should not be entered between May and November because of the scarcity of water and that they are so rugged and forbidding as to present grave danger at any season. Local records show that around twenty persons have lost their lives in the barren area.

The legend of the lost mine has it that two Spanish brothers, named Peralta, discovered the rich lode and mined it for several years until driven off by Apache Indians. Years later, Jacob Walz, who went under the name of "Snowbeard the Dutchman," supposedly rediscovered the mine but died in 1892 without revealing its location. Experienced prospectors have meanwhile combed the mountain fastness without success, and it is the opinion in Arizona mining circles that purveyors of maps to gullible fortune seekers have made more money than ever came out of the vanished mine.

* * *

Air-Driven Mine Lights in Britain

Mine lamps operated by compressed air are being used increasingly in British collieries, according to the *Iron and Coal Trades Review*, a London publication. A recent model approved for service in gaseous atmospheres consists of twin 18-inch, 15-watt fluorescent tubes. Current at a frequency of approximately 350 cycles is furnished by a turbogenerator driven by compressed air at 35 psi. Air at any pressure within a range of 35-100 psi. is taken from the mine supply line and automatically reduced to the operating pressure by a spring-loaded valve. Consumption is about 6 cfm.

Air discharged from the turbine enters the main lamp chamber and maintains back pressure of 2½ psi. on a diaphragm. If any part of the light is smashed, the back pressure is released. This permits the diaphragm to move and, through connections, to short-circuit the generator, thus cutting off the flow of power. In the Chislet Colliery in Kent up to fifteen of these lamps are strung at 5-yard intervals above a scraper-chain conveyor to illuminate the mining face. They are also used at loading and transfer points and elsewhere. Aside from being safe, the workers appreciate the cooling and ventilating effect of the discharged compressed air.

A small, portable air-operated lighting plant, the Airlite, was recently introduced in the United States by Ingersoll-Rand. It weighs less than 9 pounds and furnishes current for two 75-watt incandescent lamps, consuming air at 90 psi. at the rate of 10 cfm. It is designed for service in metal mines and for night illumination on construction jobs.

ACME NEWSPICTURES

LIKES HER JOB

The attractive paving-breaker operator is Miss Lucille Ball of the movies. The scene is from a forthcoming film, "Miss Grant Takes Richmond," and this bit of action has something to do with relieving the housing shortage. The actress obviously finds it great fun running the easy-handling L-54. But who wouldn't at her salary?

* * *

Water Tunnel Cable

An electrical cable to transmit power through the Continental Divide will be incorporated in the 13-mile Alva B. Adams Tunnel that delivers water from the western to the eastern slope in Colorado. It will be encased in a pipe filled with gas under pressure to keep out moisture. The original plan to run a tower transmission line over the summit of the Divide was dropped when alternate bids disclosed that $500,000 could be saved by the tunnel scheme. The U. S. Bureau of Reclamation then let a contract for $986,000 covering the installation.

Although there is a possibility that cable trouble might necessitate stopping the flow through the tunnel to make repairs, it is believed that the attendant risks are no greater than those that would be involved in maintaining a transmission line extending over almost inaccessible peaks under the severe winter conditions that prevail in the territory concerned. The 69-kilovolt circuit will carry power, generated by falling water on the eastern slope, to the western-slope Granby Dam pumping station. The latter will, in turn, elevate more water to be sent through the tunnel to the east side. Part of the Colorado-Big Thompson Project, the tunnel is now used only during the summer irrigation season, so the cable can be placed without interfering with operations.

—AIR JETS—

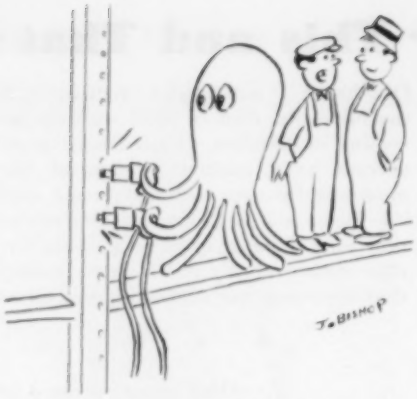
NAMING A NEWSPAPER

"Cy" Warman made the timberline town of Creede, Colorado, nationally famous with his immortal Song of Creede: "It's day all day in the daytime, and there ain't no night in Creede." Warman's contemporary mine-town journalist, Grant Jones, put Dillon, Wyoming (now a ghost town), on the map with his mountain weekly, The *Dillon Doublejack*. A lunger and dipsomaniac whose name had been familiar in the by-lines of the Chicago Daily Mail and Times-Herald, Jones landed broke and sick in the mine boom town whose main hostelry didn't charge for meals and lodging—only drink. And some local boosters set him up with a shop. In the couple of years of life remaining to him, he endeared himself to all the West and especially the mining West. His paper was named for the heaviest hammer used by the men he admired, and was inscribed as follows:

"To the most distinctive brotherhood in the world, the boys of the drill and pan . . .

"To the brotherhood whose members see the word 'welcome' on fewer doormats, and know more about hospitality, travel more miles and see fewer railroad tracks, eat more bacon and see fewer hogs, drink more condensed milk and see fewer cows, worship nature more and see fewer churches, regard women with more chivalry and see less of them, judge men better and wear fewer starched shirts, undergo more hardships and make fewer complaints, meet more disappointments and retain more hope—than any other class of men in the whole wide world—to the brotherhood of quartz and placer prospectors and miners—I dedicate the Dillon Doublejack." — SHORT STORIES MAGAZINE

"They felt so good on my motorcycle I put them on here."



"He's better than any two men on the job."

AUSSIE SPOOFING

An Australian friend tells us of an interesting kangaroo-powered mine in his country. As the ore is soft and considerably fractured, the intelligent animals have been trained to scratch it down from the face with their front paws. They then load it in their pouches and carry it out to the mill. The mine is, of course, in the Broken Hill section of the commonwealth.

FORTUNE TELLING

It is claimed by some that the principles of the world's great religions were based on superstition and fear of the unknown. How true this is I am not prepared to argue here, but I do know that anything that savors of the supernatural has a magnetic attraction for most people, the attraction usually being in direct proportion to the educational limits of the subjects. Throughout our larger cities and towns quacks are quacking quite a comfortable living from the stars, but chiefly from the 'star turns' who visit the dens day after day in the hope of being told some secret which already they generally know.

Some years ago I was part of a fortune-telling scheme which was 'palmed' on the gullible youths and maidens of a mining camp, a scheme to raise money for a very deserving purpose. And never were facts more truly told; and never was a school of spellbound suckers so satisfied.

The fortune teller, who in reality was a shift boss with a flair for acting and a nose and ear for local gossip, was arrayed in the gaudy, flowing robes of a Hindu of high caste. His disguise was perfect and his English efforts a masterpiece. The high-caste role was maintained throughout the numerous seances, for the shikaric shifter cast a spell upon all who entered his domain, and at four bits a spell. Of course all clients were told absolute facts, for Prince Razzemalli, the assumed professional name of the 'shifty one,' knew everything there was to know about everyone in camp, and much that they scarcely knew themselves. His supposedly supernatural powers were soon being discussed from one end of camp to the other, and in no time at all there was a long queue of half-dollar dupes crowding for entrance to the sanctum of mystery. Here, as a sample, is a resumè of the session which terminated a lucrative day's work, and which I overheard from 'behind the mystic veil.'

Enter husky miner with a foolish grin on his face and a do-your-darndest-but-you-can't-fool-me look in his eyes.

Prince Razz—Put zee left hand on zee creestal and zee feefty cents in zee box here. Thankee you, sahib.

Scorpio, scorpiavi, scorpiatum, scorpiare. Zee creestal shows me zee geerl you will marry.

Eet ees Bella Balone.

Miner—Well, I'll be go to . . .

Razz—But zee creestal, eet tells me more. You won Bella's engagement reeng een a poker game een Red Lake seex months ago.

Miner—Well, I'll be go . . .

Razz—And you cheated een that game. Ah, yes, sahib, you cheated zee man who ees even now your sheeft boss.

Miner—Well, I'll be . . .

Razz—And then you cheated heem out of thee leetle redhead waitress from zee Northern Cafe.

Miner—Well, I'll . . .

Razz—And steel you cheat een zee mine. Steel you carry away zee deenamite and zee caps een your leetle lunch pail to blast on your claim. But zee sheefter ees wise to you, sahib.

Miner—Well. . . . That's what you think. And that's what the punk shifter thinks.

Razz—That ess what we both know now . . . you damned double-crosser. You're fired. Get out and take your lousy half dollar with you.

—W. B. PATON
In Western Miner

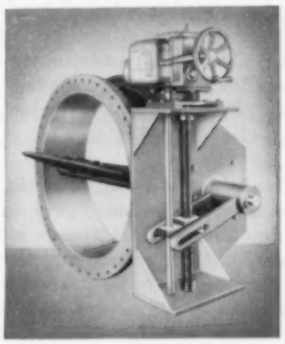
"You understand, this is only till we get the regular bulldozer fixed."

Industrial Notes

The Cleveland Vibrator Company is producing a new line of air-operated vibrators for a wide range of applications where constant or intermittent shaking is essential to efficient operation. Series SA includes seven sizes from 5 3/8x7/8x1 1/2 inches to 8x1 3/4x2 1/4 inches with five different mountings, as shown. Air consumption varies from 5 to 8 1/2 cfm. at 80 psi. line pressure, and operating speeds range from 5100 per minute for the smallest size to 1950 for the largest. Units are recommended for service where intermittent or constant vibration is necessary such as in removing patterns from sand molds; hopper, chute, or tube feeding of granular materials or of small parts for assembly; settling products during packaging or concrete mix in block-making machines; and in fatigue testing assemblies.

Shown in the accompanying illustration is a Model 3-A Air Backstand designed by Hammond Machinery Builders, Inc., for heavy production grinding or polishing with abrasive belts. The unit has a pneumatic cylinder which automatically maintains correct belt tension, it is claimed, compensating instantaneously for a fraction of an inch belt stretch. Tension depends upon the work being done, and once it is determined the operator merely sets a pressure-regulating valve. The Backstand, of heavy cast iron, has a stainless-steel 12-inch-diameter, 7-inch face idler pulley that is diametrically balanced and runs on sealed ball bearings.

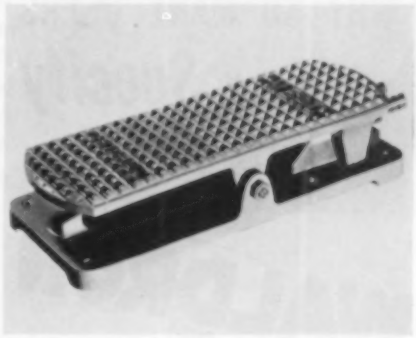
A 54-inch, 50-pound iron valve for hydraulic service has been developed by R-S Products Corporation. Designed especially for controlling the flow of condenser water, it is of rugged construction, has 125-pound American Standard flanges, and is operated by a Limitorque electric motor connected to a threaded reach rod that moves it slowly to prevent water hammer. The threads can be cut for speeds ranging from 60 seconds to a maximum of eight minutes. When fitted



with a renewable rubber spool, the unit is said to provide bubbletight shutoff with air up to 80 psi. and commercial tight shutoff with water up to 100 psi. The picture shows how a wedgetight closure is effected by a vane or disk. Larger valves for higher pressures are obtainable and in metals other than iron.

Felseal, a thiokol coating for fibrous-type base materials for gaskets and other seals, has lately undergone improvement, according to the producer, the Felt Products Manufacturing Company, 1508 Carroll Avenue, Chicago 7, Ill. Applied in films from 0.001 to 0.005 inch thick to low-cost chipboard, treated paper, and the like, it provides seals that are said to remain effective under service temperatures from 30 degrees below Fahrenheit to 225 degrees above and that are affected little if any by mineral or vegetable oils, aliphatic and aromatic hydrocarbons, dilute acids, lower alcohols, etc. Test samples of Felseal may be obtained free of charge by industrial executives and product development engineers.

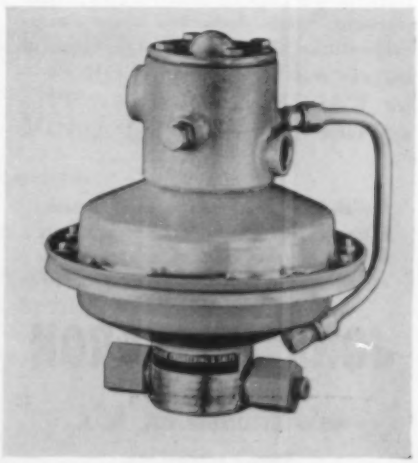
In designing its new Model 201 foot-controlled 3-way air valve, Mead Specialties Company aimed at durability and ease of operation. The treadle is large and set at an angle to provide a comfortable foot rest, is pivoted on centers for smooth action, and movement from full-closed to full-open position is reduced to a minimum to obviate muscular



fatigue. The valve is of self-cleaning, poppet-type construction, and with the insertion of a return spring that comes with it is really four valves in one: normally closed, either self-locking or self-releasing; and normally open, self-locking or self-releasing.

For application where the familiar infrared lamp with reflector is too bulky, the Miskella Infra-Red Company has developed an insulated lampless unit that fits into a space of but a few inches, as against a minimum of 12 inches for the other type. Named Spir-O-Therm, it consists of a pyrex tube with a spiral channel resistor, stainless-steel contacts, and a reflector, all mounted diagonally in sets of two, four, eight, or twelve. Maximum working temperature obtainable is 500°F., and average life is said to be 10,000 hours.

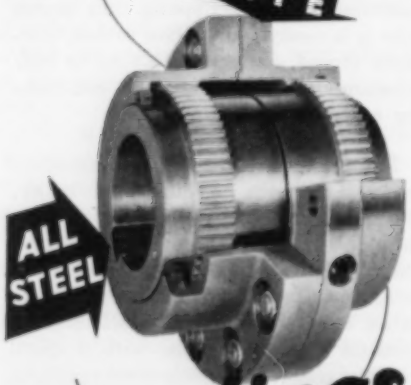
After four years of development and testing, Sprague Engineering & Sales is now offering industry a new air-operated high-pressure, hydraulic boost pump, Model C, that is recommended for numerous press applications, clamping,



IT'S EASY
TO UNDERSTAND
WHY SO MANY USERS
NOW *Specify*

WALDRON

GEAR TYPE



ALL STEEL

Couplings

These users want not only a gear type coupling but also a WALDRON Gear Type. They recognize the WALDRON as the most advanced design of the gear type. From a standpoint of shaft size, horsepower, speed and service, comparison with ordinary type couplings make the choice easy. Careful buyers now specify WALDRON—for WALDRON means Gear Type and Gear Type means WALDRON.

• •

For design and construction details, ratings, service factors and others details on the kind of coupling you require, write for our Catalog No. 57

JOHN WALDRON

CORPORATION
NEW BRUNSW CK, N. J.

Agents in principal cities

shearing, static testing, metal forming, jacks, pullers, etc., where rapid ram travel is desired. Unit is capable of making 120 strokes a minute, it is claimed, and hydraulic pressures from 1000 to 30,000 psi. are obtained with shop air at 100 psi. High hydraulic pressures are controlled by regulating the air inlet pressure. Pump is of special corrosion-resistant construction for use with oil, water, or other fluids. It is furnished separately, or complete with power unit, the Model C-R, which includes reservoir, pressure gauge, and control valves, ready for installation.

Among new devices for the medical profession is a vacuum cup for use during prolonged surgery where the heart shows signs of failing. To restore normal pumping of blood, the exposed organ is massaged with the cup.

Although made primarily for the canning industry, Goodrich Company's new rubber gloves with roughened fingers and palms to insure a firm grip on slippery objects can be used to advantage wherever work immersed in liquids has to be handled. They are 11 inches long and range in size from 7½ to 11.

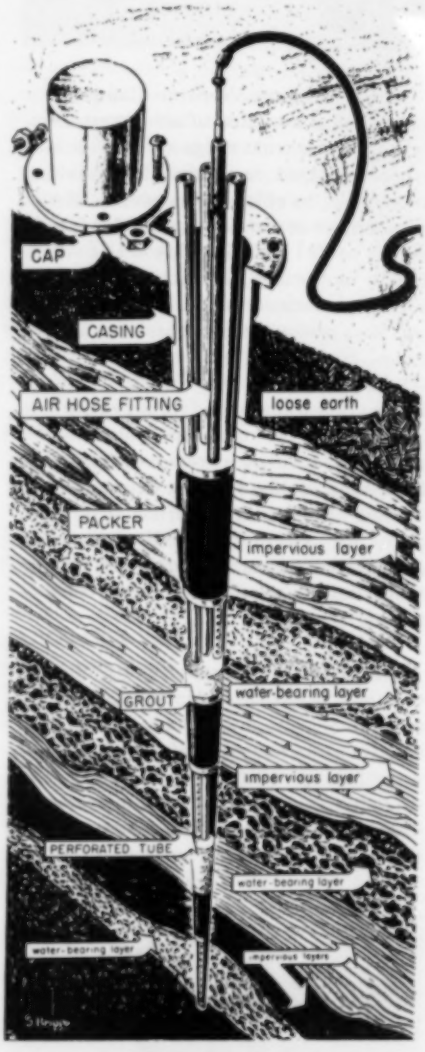
Nu-Era is the name of a plastic putty that has been compounded primarily for use in dry climates. It is a product of American Laboratories, which claims that it will remain in its original condition indefinitely because it is weather-, water-, and fireproof; expands and contracts with temperature changes; and will not crack and crumble. Suitable for packing, sealing, and glazing.

Carbo-Flex is a new thermosetting resin made by the Carboline Company for lining wooden tanks. It is also suitable for coating concrete floors that carry heavy traffic. Material is said to have a compressive strength of 10,000 psi., and to be highly resistant to acids, alkalies, and solvents at temperatures as high as 325°F. It is applied directly to clean surface with a trowel.

According to a recent announcement, Dow Chemical Company is prepared to grant any established manufacturer free use of its recently developed plating process for magnesium products provided it has free access to any improvements made by the licensee. By the method, clean magnesium parts are immersed in a zinc-salt bath before they are electroplated.

For a dollar you can buy a new 6-foot, zigzag folding rule that is fully guaranteed against breakage and loose joints by the Durall Tool Corporation of Yonkers, N. Y. Made of specially hardened and tempered alloy steel with white-enamel finish, it can be bent and twisted like a pretzel, it is claimed, and yet spring back to normal shape. It can be used to take out-of-reach measurements, inside measures of rounds and ovals, and as a straightedge. Rule weighs 3 1/5 ounces.

Reynolds Metals Company is offering solders made from powdered aluminum for filling in dents and damaged areas in painted, enameled, or lacquered sheet metal. The coatings are not damaged, it



A $10,000,000 IDEA

Sketch shows the working principle of a multiple packer for diamond-drill holes which U. S. Bureau of Reclamation engineers estimate will save a million dollars on projects now in progress and ten times as much in years to come. It permits sealing off up to eight water-bearing horizons for study and flow measurement. Only two could be measured with the equipment used previously, so more holes had to be drilled for testing dam foundations. The packers, which are rubber cylinders, are expanded in the hole with compressed air to make a tight fit. Water from the various levels is brought to the surface through individual pipe lines. E. D. Rhoades, a veteran diamond driller, received a $1000 award from the Department of the Interior for the invention. The Government intends to license the use of the packer.

AUTOMATIC PULMOTOR

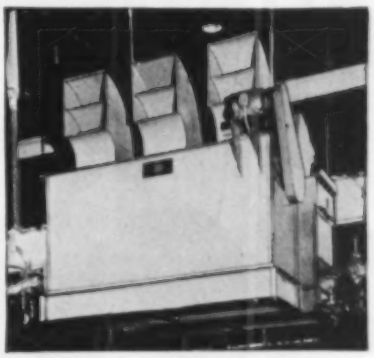
Known as a Pneophore, this apparatus takes over the job of breathing for persons whose respiratory organs have ceased to function because of exposure to electrical shock, irritant or poisonous gases, etc., or for victims of heart attack, asthma, or similar ailments. A double-acting valve feeds oxygen from a cylinder to the lungs under intermittent pressure. The flow is shut off when lung capacity is reached, whereupon muscular reaction causes exhalation. The device was developed during the war for the treatment of wounded airmen who could not breathe with standard oxygen equipment. It is manufactured by Mine Safety Appliances Company. The unit shown is in the plant hospital of the Spang-Chalfant Division of the National Supply Company at Ambridge, Pa.

is claimed, because soldering is done without heat. Solvent evaporates upon application by spatula or wiper, and metal soon hardens sufficiently to permit filing or sanding preparatory to resurfacing. Can be built up to a maximum thickness of 1 inch.

Damage to moving parts such as piston rings and gears by ferrous particles in oil lines can be prevented, it is claimed, by a magnetic plug that has recently been announced by the U. S. Plug & Fitting Company. The magnet used is of the permanent Alnico type and has a tractive force of 11 ounces. It is attached to the plug by a nonferrous metal stem that may be varied in length to permit placing it at a point in the oil stream where it will do the most good. Plugs are available in a ¼- to 1½-inch size range in standard square-head, countersunk, and special designs with Dryseal threads that are said to insure leakproof seals without the use of pipe dope or compounds. They can be readily cleaned with a blast of compressed air.

New HIGH PRESSURE STEAM Fan Heater

Gives Savings You Never Had Before



The first heater to make High Pressure Steam really trouble-free and practical in plant heating. Every engineer should understand its original method; write for Niagara Bulletin and performance data.

HOW IT OPERATES: — A dual coil system makes use of all heat, both sensible and latent. High pressure steam enters the upper coil, shown on the diagram below. Its condensate drains into a trap. Then this high pressure condensate is released into the header of the lower coil. It instantly flashes into steam at vapor pressure.

Any high pressure condensate that remains liquid is carried to the vapor condensate return header by a drain tube that also gives off its heat into the air stream.

The vapor condenses in the lower coil. Its condensate is kept at a high level in the return leg by a wier in the return header so that all its heat is made useful and it is sub-cooled by contact with the coldest air entering the heater. Vacuum condensate return to boiler is vapor free.

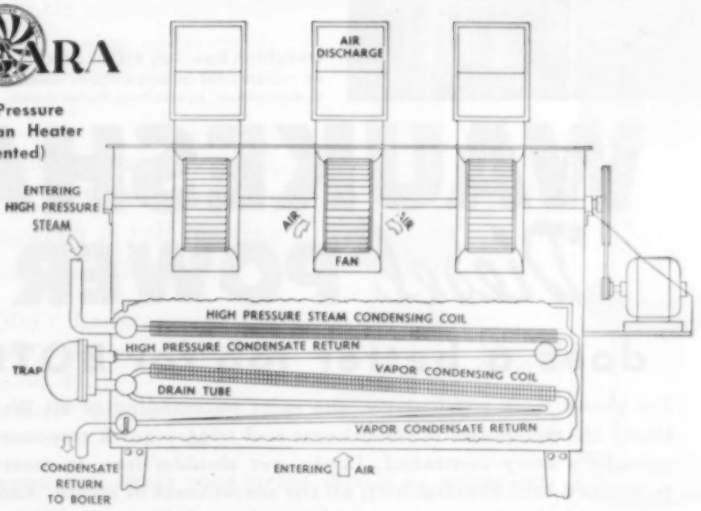
HOW IT SAVES IN COST: — Piping is much simpler and less costly than in low pressure systems. Much secondary piping, traps and big valves are not needed. Pipe sizes are smaller.

HOW IT SAVES IN OPERATION: — Waste is prevented. Every BTU goes where you want it. No dump traps or hot wells waste live steam.

HOW IT SAVES IN UPKEEP: — Condensate flow is even, vapor free, easily handled. No sudden surges of condensate in starting. No hammering, no hard wear and tear on system. Properly engineered for the job, final air temperatures are not excessive; heat easily directed where needed; no flashing of low pressure condensate. Heaters are self-draining on shut-down. Heaters are strongly built; all coils including the condensate drain tubes are hairpin bend, stress relieving. Use thru four heating seasons has proven these advantages in large scale plant heating.

NIAGARA

High Pressure Steam Fan Heater (Patented)



NIAGARA BLOWER COMPANY

Dept. CA 405 LEXINGTON AVE., NEW YORK 17, N. Y.

Please send Bulletin 109 on the Niagara High Pressure Steam Fan Heater.

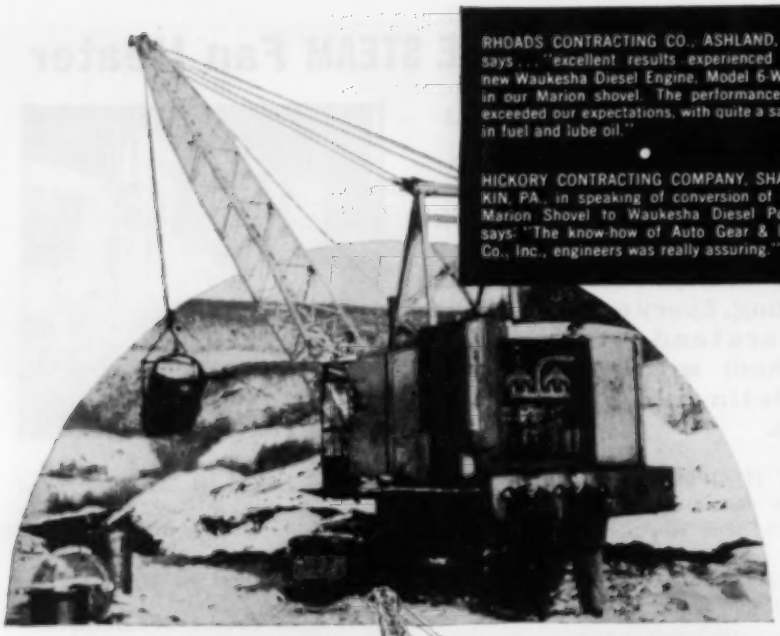
Name .....

Address .....

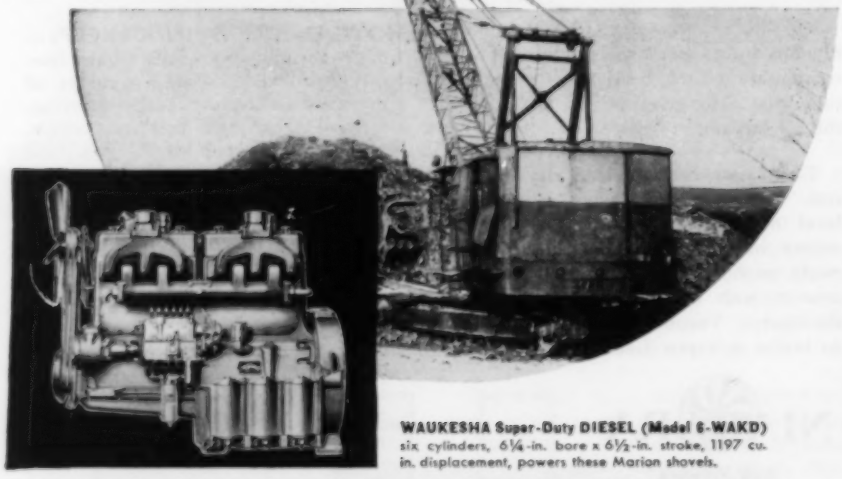
RHOADS CONTRACTING CO., ASHLAND, PA., says . . . "excellent results experienced thru new Waukesha Diesel Engine, Model 6-WAKD in our Marion shovel. The performance has exceeded our expectations, with quite a saving in fuel and lube oil."

•

HICKORY CONTRACTING COMPANY, SHAMOKIN, PA., in speaking of conversion of their Marion Shovel to Waukesha Diesel Power, says: "The know-how of Auto Gear & Parts Co., Inc., engineers was really assuring."



2 CONTRACTORS . . . 2 SHOVELS . . .



WAUKESHA Super-Duty DIESEL (Model 6-WAKD) six cylinders, 6¼-in. bore x 6½-in. stroke, 1197 cu. in. displacement, powers these Marion shovels.

WAUKESHA *Diesel* POWER

does a better job for BOTH!

For shovel work particularly, the most outstanding of all Waukesha Diesel characteristics is smoothness and trigger-quick response to the operator's every command. Lively, yet shudder-free, it meets every power and load demand with all the smoothness of steam. And that's a new experience, even to an old Diesel hand. Clean burning, its fuel economy is excellent. Built with rugged simplicity. Such features as hard, wet cylinder sleeves, simple overhead valve mechanism, gear-driven water pump cooling, and pressure oiling—all make the Waukesha Diesel easy to understand and simple to service. For all the details, send for Bulletin 1415.

WAUKESHA MOTOR COMPANY, WAUKESHA, WISCONSIN

NEW YORK TULSA LOS ANGELES

ADV. 17 (216)

Industrial Literature

A folder describing the advantages and economies incident to the use of factory-fabricated piping units can be obtained from Crane Company, 836 South Michigan Avenue, Chicago 5, Ill. The service offered entails welding valves, headers, and other piping components into one-piece assemblies that are convenient to handle. Pretested in the shop, the units are shipped to the job, ready to be set in place in piping systems.

The application, installation, and means of control of large synchronous- and induction-type alternating-current motors in pulp and paper mills is discussed in the No. 26 issue of *E-M Synchronizer*. Also contained in the 20-page publication is a good deal of interesting information on the history and development of the paper-making industry. Copies may be obtained free of charge from Electric Machinery Manufacturing Company, Minneapolis 13, Minn.

A new General Electric line of fractional-horsepower motors is described in Bulletin GEC-489 obtainable from the company at Schenectady 5, N. Y. Known as Type KH, they are intended for use in connection with accounting machines, typewriters, and other business machines. They are of open, ventilated, sleeve-bearing construction, weigh about 4 pounds, and are available in ratings of 1/40 and 1/20 hp. An externally mounted starting switch includes a thermal cutout that prevents motor damage in case a machine jams.

Alloy steels for ball-mill liners and grates are discussed in Bulletin 449-ML of the American Manganese Steel Division of the American Brake Shoe Company, 230 Park Avenue, New York 17, N. Y. The 12-page booklet makes recommendations as to the alloy steel or iron that will best meet different conditions of impact and abrasion encountered in grinding-mill installations in such basic industries as metal mining, nonmetallics, and Portland cement. Characteristics, qualities, and uses are described in detail in the bulletin, copies of which will be mailed upon request.

International Nickel Company, Inc., 67 Wall Street, New York 5, N. Y., will send upon request a bulletin entitled *Basic Application Data* which suggests the thicknesses of soft-tempered Monel sheet material best suited for roofing and other exterior building purposes. The suggestions are based on records of Monel installations that have withstood prolonged exposure under severe climatic conditions or unusual atmospheric concentrations of smoke, dust, fumes, or corrosive agents. According to the company, Monel's high resistance to corrosion and its good mechanical properties permit the use of lighter gauges than those normally needed in the case of standard roofing and other sheet metal.

Valves, cylinders, and other equipment for the control or utilization of air power are described in a bulletin recently issued by the Lehigh Air Control Division of Lehigh Foundries, Inc. Listed are many types and sizes of valves designed for either hand, foot, or solenoid control and for 1-, 2-, 3-, or 4-way operation. Several combinations of valves with their accessory equipment are shown, an example being a 4-way, disk-type, hand-operated valve for pressures of 10-200 psi., with air gauge, lubricator, pressure regulator, and strainer to form a single unit for air-line installation. Complete panel and cabinet units for hand or solenoid control also are covered, as well as single- and double-acting air cylinders in several sizes

and a pneumatic vise for speeding core-box repairs in foundries. Copies of the bulletin may be obtained from the company at 1500 Lehigh Drive, Easton, Pa.

A space heater that, in addition to its primary purpose of comfort heating, can be used for year-around ventilation, process drying, tempering make-up air, or for heat curing materials is described in Bulletin No. 523 of Dravo Corporation. Having a stainless-steel combustion chamber, the unit is available in standard sizes with output capacities from 400,000 to 2,000,000 BTU's an hour. It may be direct-fired by either oil or gas and can be quickly converted from one fuel to the other. A copy of the publication will be sent upon request to the company at Fifth & Liberty Avenues, Pittsburgh 22, Pa.

Allis-Chalmers Company, Milwaukee 1, Wis., will send to interested persons copies of Bulletin 05B6031B which describes high-speed, coupled-type, alternating-current generators designed to meet the requirements of relatively small, isolated loads. Available in a wide range of ratings, the machines may be direct-coupled to steam or internal-combustion engines, geared to steam turbines, or driven through flat or V-belts. Internal-combustion-engine units may be mounted on wheels or skids to form portable power and lighting plants for construction jobs, small mines, quarries, and plants in remote areas, for marine use, and to serve as standbys in factories or pumping stations.

Silicone greases as ball-bearing lubricants are the subject of two publications recently issued by Dow Corning Corporation, Midland, Mich. Silicone Notes No. D-5 gives the properties, performances, and applications of these heat-stable and oxidation-resistant lubricants that are suitable for temperatures up to 400°F. Silicone Notes No. D-6 tells how to use DC-44 silicone grease in the bearings of electric motors and gives instructions and relubrication schedules for both open and shielded ball bearings. Also discussed are double-shielded and cartridge-type ball bearings permanently prelubricated with DC-44 for household appliances and industrial equipment.

B. F. Goodrich Company, Akron, Ohio, will send upon request copies of three new bulletins describing its air, steam, and fire hoses. Bulletin No. 3460 features the company's "Highflex" air line, a recent product that weighs only half as much as conventional hose designed for the same working pressure. It is available in five sizes ranging from $\frac{3}{16}$ to $\frac{1}{2}$ inch and is also suitable for other services such as welding, carrying petroleum solvent and lubricating oil, and in low-pressure hydraulic systems. Bulletin 3740 deals with the company's varied types of fire hose, listing sizes, weights, test pressures, and fittings. Bulletin 4500 similarly treats industrial steam hose.

A new device for positively sealing the edges of longitudinal baffles in 2-pass, shell-type heat exchangers is described in a folder issued by Henry Vogt Machine Company. It consists of a compression mechanism composed of a series of longitudinal, pivotally connected steel links, of a steel backing strip, and of suitable packing. When the assembly is in position between the baffle plate and the shell, compression is put on each end of the linkage mechanism by an adjustable nut. This causes the links to move outward togglelike against the backing strip, making the packing conform to any unevenness in the shell. Copies of the folder may be obtained by writing to the company at Tenth & Ormsby streets, Louisville 10, Ky.

"VIC" TELLS HOW

AN *ALL VICTAULIC* PIPING SYSTEM FITS *ALL* YOUR PIPING NEEDS!

Troubled by piping problems? Here's the *best* answer to your piping requirements. Victaulic Couplings and Victaulic Full-Flow Elbows, Tees and other Fittings will save you time . . . work . . . money! You just can't beat a Victaulic Installation for on-the-job flexibility and pipe line economy.

A simple two-bolt design assures quick assembling and 100% dependability for all Victaulic Couplings and Fittings. No special skill required—a standard T-Wrench is the only tool necessary to make connections. You get tops in construction simplicity, PLUS sure-locked, leak-proof joints . . . even under conditions of excessive pressure, vacuum or strain!

AND for fitting those pipe ends, easy-to-use "Vic-Groover" grooves 'em *automatically* in half the time of conventional pipe threader!

WRITE TODAY for these two:
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"Vic-Groover" Catalog No. VG-47.

Sizes—¾" through 60"

FOR FULL ECONOMY...MAKE YOUR PIPING SYSTEM ALL VICTAULIC!

SELF-ALIGNING PIPE COUPLINGS
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EFFICIENT FULL-FLOW FITTINGS

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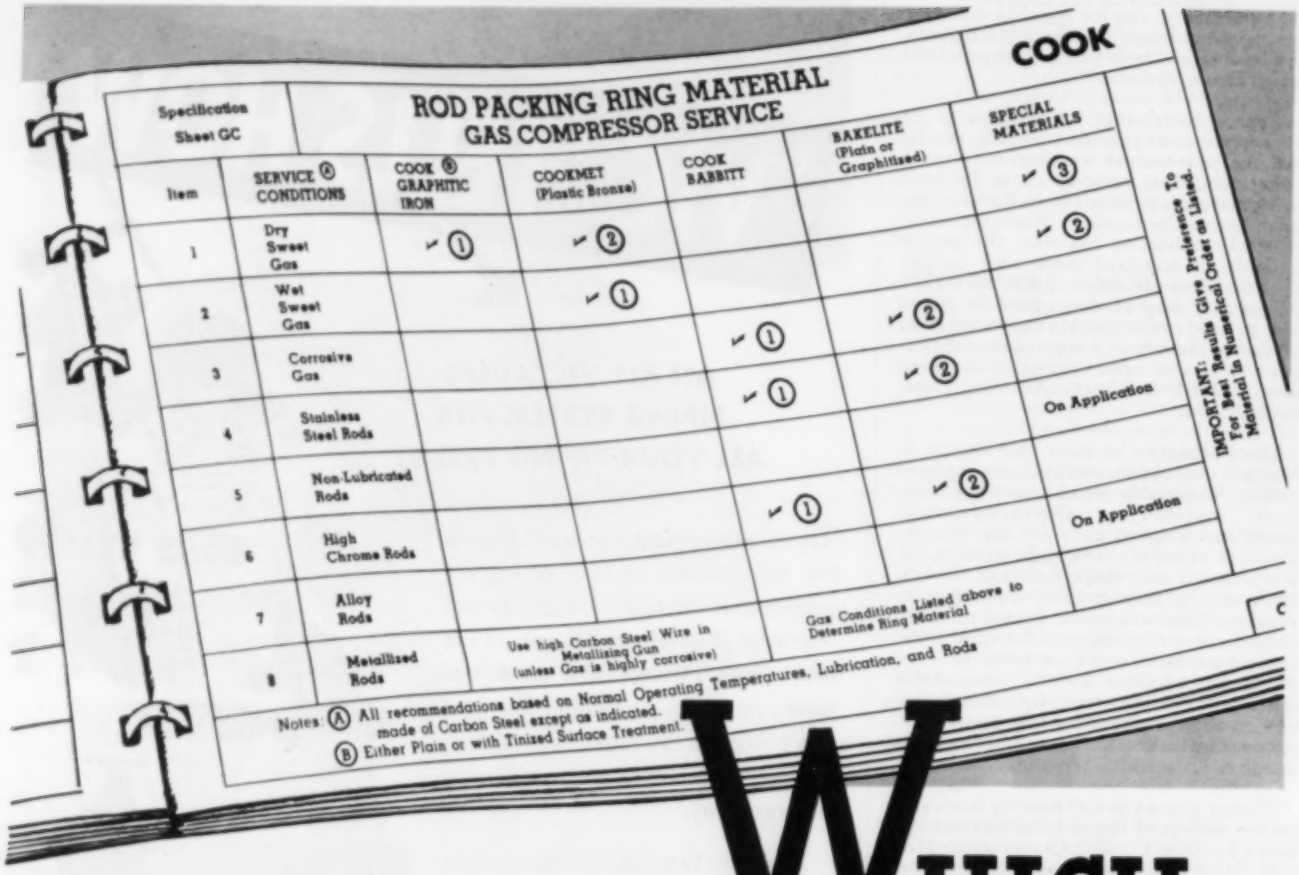


Specification Sheet GC

ROD PACKING RING MATERIAL
GAS COMPRESSOR SERVICE

COOK

Item	SERVICE (A) CONDITIONS	COOK (B) GRAPHITIC IRON	COOKMET (Plastic Bronze)	COOK BABBITT	BAKELITE (Plain or Graphitized)	SPECIAL MATERIALS
1	Dry Sweet Gas	✓ (1)	✓ (2)			✓ (3)
2	Wet Sweet Gas		✓ (1)			✓ (2)
3	Corrosive Gas			✓ (1)	✓ (2)	
4	Stainless Steel Rods			✓ (1)	✓ (2)	On Application
5	Non-Lubricated Rods					
6	High Chrome Rods			✓ (1)	✓ (2)	On Application
7	Alloy Rods					
8	Metallized Rods	Use high Carbon Steel Wire in Metallizing Gun (unless Gas is highly corrosive)		Gas Conditions Listed above to Determine Ring Material		

IMPORTANT: For Best Results Give Preference To Material In Numerical Order as Listed.

Notes (A) All recommendations based on Normal Operating Temperatures, Lubrication, and Rods made of Carbon Steel except as indicated.
(B) Either Plain or with Tinised Surface Treatment.

WHICH RING MATERIAL FOR YOUR GAS COMPRESSOR PACKINGS?

This is an important question—one that is answered many times each day by Cook engineers, both in the field and in the designing department.

Of course, the solution depends on many operating variables, just a few of which include the nature of the gas, operating pressures, rod material and type of lubrication used.

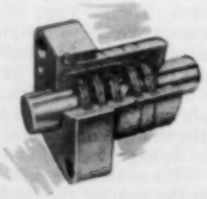
And, because the co ditions determined by these variables differ so widely, Cook has developed and maintains a wide range of ring materials to suit almost any requirement.

So, if there is any question as to the correct material for your use, or if your gas conditions have changed, call in the Cook field engineer—the service is free—the results may improve the efficiency of your machine.

And remember, too, that you can get immediate delivery of Cook Rings from our warehouse stocks in both the Mid-Continent and Los Angeles territories.

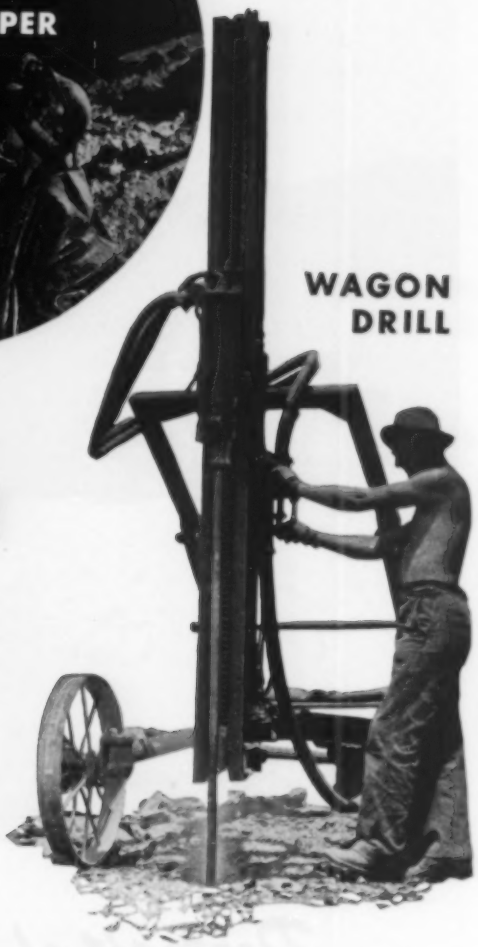
C. Lee Cook Mfg. Co., Inc., Louisville, Ky. Branch Offices in Baltimore, Boston, Chicago, Cleveland, Houston, Los Angeles, Mobile, New Orleans, New York, San Francisco and Tulsa.

COOK
ROD PACKINGS



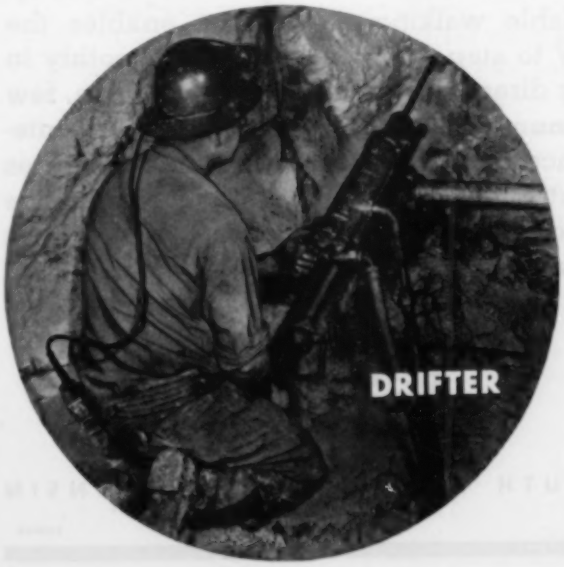
. . . SEALING PRESSURES SINCE 1888 . . .

all at their best with BETHLEHEM HOLLOW DRILL STEEL



Modern rock drills are making possible faster drilling at lower cost than ever before. But if you want to be sure of the best drilling combination, you'll need top-quality drill steel. Specify Bethlehem Hollow and you'll see what we mean. This fine steel is tough and fatigue-resisting all the way through. Its hardenability is closely controlled to insure the uniformity of each bar. The wide quenching-range makes it easy to heat-treat. The center hole is smooth and true, minimizing fatigue-failure.

Meticulous inspection at every stage insures the undeviating quality that has earned for Bethlehem Hollow the name "old reliable." But what you'll like best is the way it stays on the job, drilling day after day. Immediate delivery from your nearest supplier or our mill.



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BETHLEHEM, PA.

On the Pacific Coast Bethlehem products are sold by Bethlehem Pacific Coast Steel Corporation
Export Distributor: Bethlehem Steel Export Corporation

BETHLEHEM STEEL

Portrait of an OUTPUT LEADER

Increasing demand for coal from open-pit mines emphasizes the importance of fast-working, dependable excavators like this Bucyrus-Erie 9-W 10-yard walking dragline. With its great range, capacity and speed, the 9-W is an output leader in moving millions of tons of overburden at exceptionally low operating and maintenance costs. Its simple design features strength for hard work in every part, yet eliminates useless deadweight that slows cycles. A wide, strong base means a firm foundation for speedy action, with center of gravity shifting only between predetermined limits, so rim pressures are low and "coning" under the base reduced to a minimum. Its sturdy, reliable walking mechanism enables the 9-W to step safely, surely and smoothly in any direction. Machine parts are large, few in number, easily accessible for maintenance. All these and many other features contribute to the outstanding performance records achieved wherever the 9-W goes to work.

BUCYRUS ERIE

SOUTH MILWAUKEE, WISCONSIN

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Often worth its weight in Gold!

When production groans to a halt because of broken or fractured equipment, many shop-owners would gladly pay the price of gold for the few ounces of bronze needed for a reliable repair-weld.

They don't have to, of course. For repair-welding with Anaconda Bronze Rods—particularly Tobin Bronze*—is a low-cost, low-temperature method of oxyacetylene welding on cast or malleable iron, steel or copper alloys.

Over the decades that time-tried Tobin Bronze has served so well, many "new" rods and procedures have sprung up with mushroom-like growth, only to disappear as quickly—victims of their own lack of dependability!

Whether you do your own repair welding or call on outside help, play it safe—insist on genuine Tobin Bronze.

49152

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General Offices: Waterbury 88, Connecticut
Subsidiary of Anaconda Copper Mining Company
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DON'T SCRAP IT . . . BRONZE WELD IT!

Bronze welding is safe, speedy and economical. Large or small, bronze welds are tough and readily machinable, high in strength and low in residual stresses—an ideal combination for repair welding, for building up worn surfaces, and for production welding, too. Tobin Bronze and other Anaconda Welding Rods are described in this NEW, 17th Edition of Publication B-13. Write for a copy.

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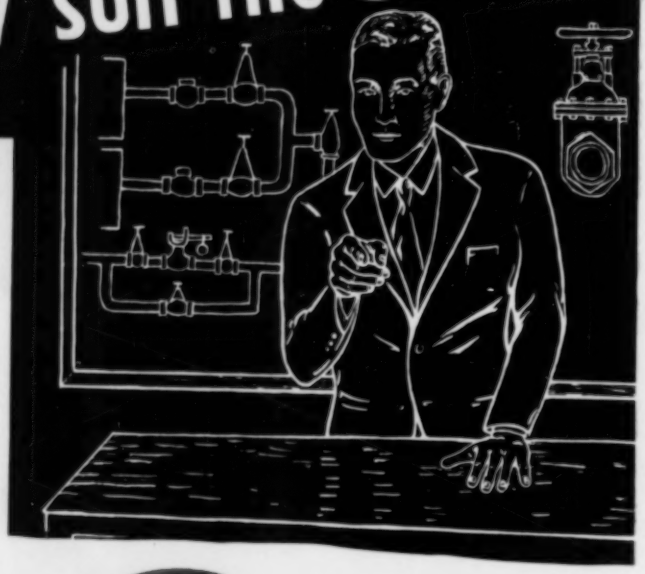
from mine to consumer

Anaconda
BRONZE WELDING RODS

1st Lesson in Flow Control — the Valve *MUST* suit the Service



It's an established fact that there's more loss in time and money through misapplication of valves than from any other known cause.

Fortunately this can be avoided. All you need to do is standardize on the Powell Line of Valves*—because this is what you get—

I More varieties and patterns than are made by any other manufacturer of valves.

II The most complete line of Standard Designs, made of standard materials, for use wherever they fill the requirements of the service.

III Many Special Designs for Special Services.

IV Valves made in the greatest variety of materials ever used in making flow control equipment.

With such facilities at your disposal and Powell Engineers always ready to help you select the right valves, why take chances with your flow control equipment. Standardize on POWELL VALVES.

* Powell Valves are made in Bronze, Iron, Steel and a wide selection of Corrosion-Resistant metals and alloys. Valves of every type—Globe, Angle, Gate, Check, Non-return and Flush Bottom Tank Valves—are included in the Complete Powell Line.

← Fig. 95—Bronze Dash Pot Check Valve for 200 pounds air working pressure. Designed for air compressor service. Has screwed ends, screwed-on cap and regrindable, renewable, wear-resisting bronze disc. Cushioning effect of plunger in dash pot makes seating of disc practically noiseless.

Fig. 375 — 200-pound Bronze Gate Valve. Screwed ends, union bonnet, inside screw rising stem and renewable "Powellium" wear-resisting nickel-bronze disc.

Fig. 150—150-pound Bronze Globe Valve with screwed ends, union bonnet and renewable composition disc.

Fig. 1708 — 200-pound Bronze Globe Valve with union bonnet, renewable specially heat treated stainless steel seat and regrindable, renewable wear-resisting "Powellium" nickel-bronze disc.

Fig. 241—Large 125-pound Iron Body Bronze Mounted Globe Valve. Made in sizes 2" to 16", inclusive. Has outside screw rising stem, bolted flanged yoke and regrindable, renewable bronze seat and disc.

The Wm. Powell Co., Cincinnati 22, Ohio

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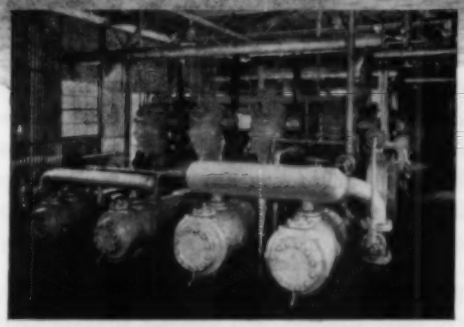
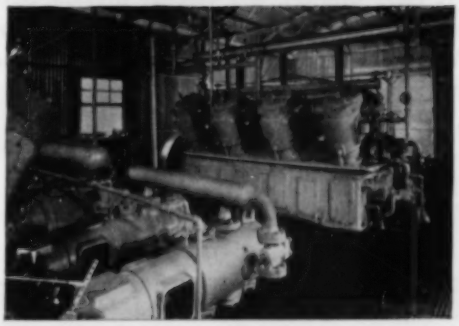
"FLOATING COMPRESSORS"
for
SHELL OIL'S GAS-LIFT
IN LOUISIANA BAYOU SWAMPLAND



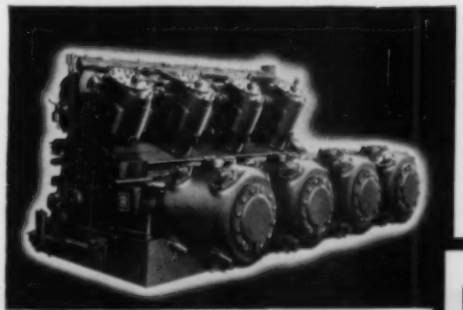


These two XVG gas-powered compressors, operating aboard Shell Oil Company's barge, provide something new in availability, flexibility, and operating efficiency.

This floating compressor plant is used by the Shell Oil Company for gas-lift and sale-gas service in Louisiana bayou swampland where it is almost impossible to get sound footing for a conventional foundation. Because it is completely self-contained, the plant is easily moved from one location to another. The compressor equipment consists of two Ingersoll-Rand 300-hp Type XVG gas-engine-driven compressors, known for their excellent running balance. An I-R Type 30 air-cooled compressor furnishes starting air for the engines.

This is the second compressor barge built for Shell by the Levingston Shipbuilding Co., Orange, Texas. The first, with a single 225-hp Type XVG compressor, has been on gas-lift service at Black Bayou, La., for some time.

These compact, 4-cycle V-angle compressors, designed primarily for oil-field and refinery service, are in use all over the world on all types of jobs . . . with outstanding records of efficiency, dependability, and low up-keep costs. For complete information get in touch with your nearest I-R engineer. He will be glad to explain the advantages of Ingersoll-Rand 4-cycle Vee compressors and gas engines.



Excellent running balance makes Ingersoll-Rand's XVG, and smaller JVG compressors, ideal for service on barges.

- **DEPENDABILITY**
- **LOAD FLEXIBILITY**
- **LOW-COST INSTALLATION**
- **SIMPLICITY**
- **CONSERVATIVE RATING**
- **BALANCE**

4-CYCLE V

Ingersoll-Rand

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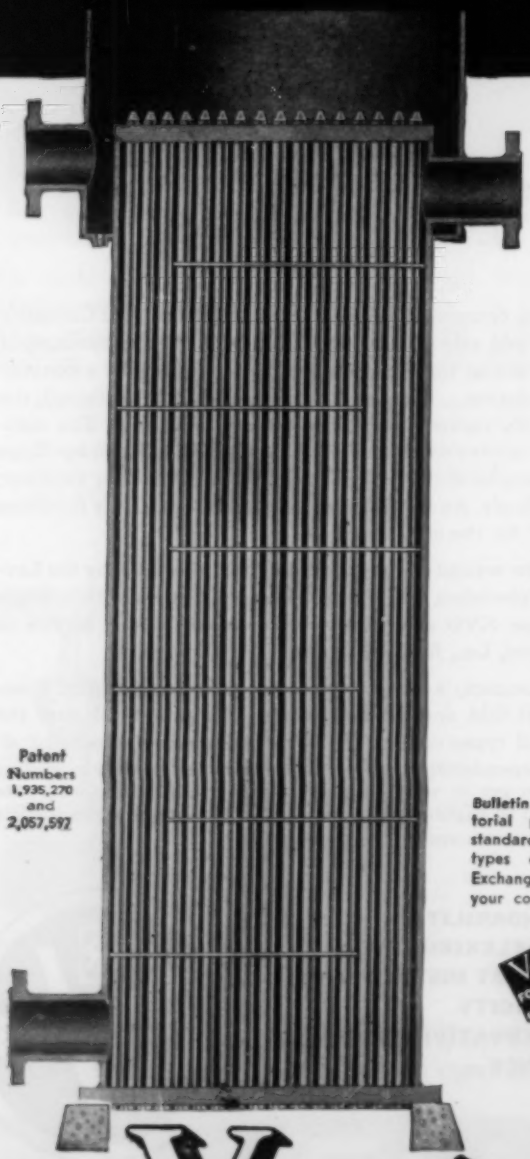
FILM TYPE EXCHANGERS

DETAIL SHOWING DISTRIBUTING FERRULE IN TUBE (Patent Pending)



Patent Numbers 1,935,270 and 2,057,597

Vogt engineers have taken a familiar refrigeration plant "old timer" and developed it into this modern, efficient heat exchanger.

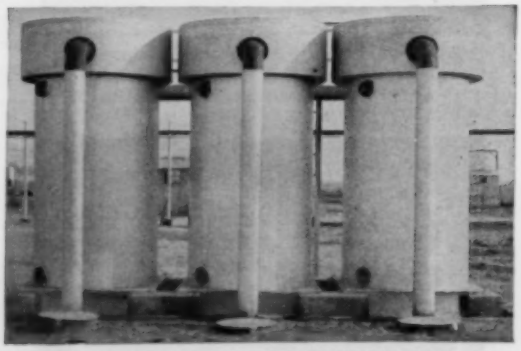
The film type exchanger operates in a vertical position. Water introduced in the top chamber is distributed in a thin film against the inner tube walls by means of special ferrules. The shell side of the exchanger has baffles arranged to provide optimum velocities, pressure drops, and heat transfer rates. Shutdowns are eliminated because tubes can be cleaned while the unit is in operation; thus permitting the use of dirty, mud and silt depositing water.

Vogt Film Type Exchangers now serve as Jacket Water Coolers, Sulphuric Acid Coolers, and Sulphur Dioxide Condensers, and can be designed to condense any vapor. They are also applicable for handling liquids other than water in film flow.

HENRY VOGT MACHINE CO., INC.
LOUISVILLE 10, KENTUCKY

Branch Offices: New York, Philadelphia, Cleveland, Chicago, St. Louis, Dallas

Bulletin HE-5 is a pictorial presentation of standard and special types of Vogt Heat Exchangers. Write for your copy.

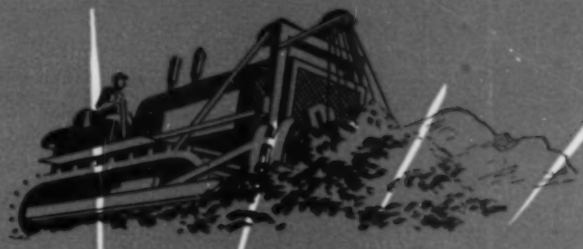


Jacket Water Coolers serving engines of 7,300 H.P. Muddy well water used as cooling medium.

Vogt

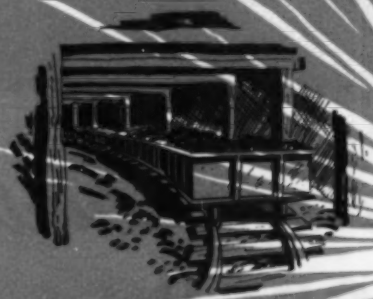
HEAT TRANSFER EQUIPMENT

QUARRYING

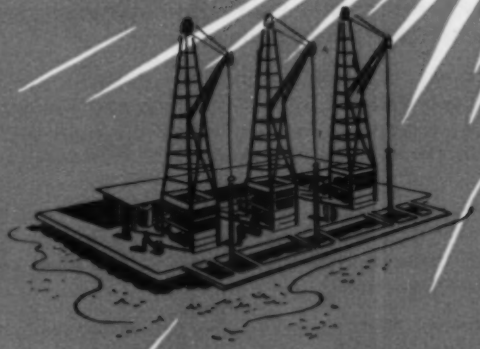


CONSTRUCTION

COAL MINING



MINING



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IN EVERY BLASTING CAP

There are five types of Hercules Blasting Caps for dependable detonation wherever high explosives are used in mining, quarrying, construction, and submarine work:

Blasting Caps: Two strengths, No. 6 and No. 8, meet all requirements for use with safety fuse.

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Write for 52-page book, "Hercules Explosives". ***HERCULES POWDER COMPANY*** *932 King St., Wilmington 99, Del.*

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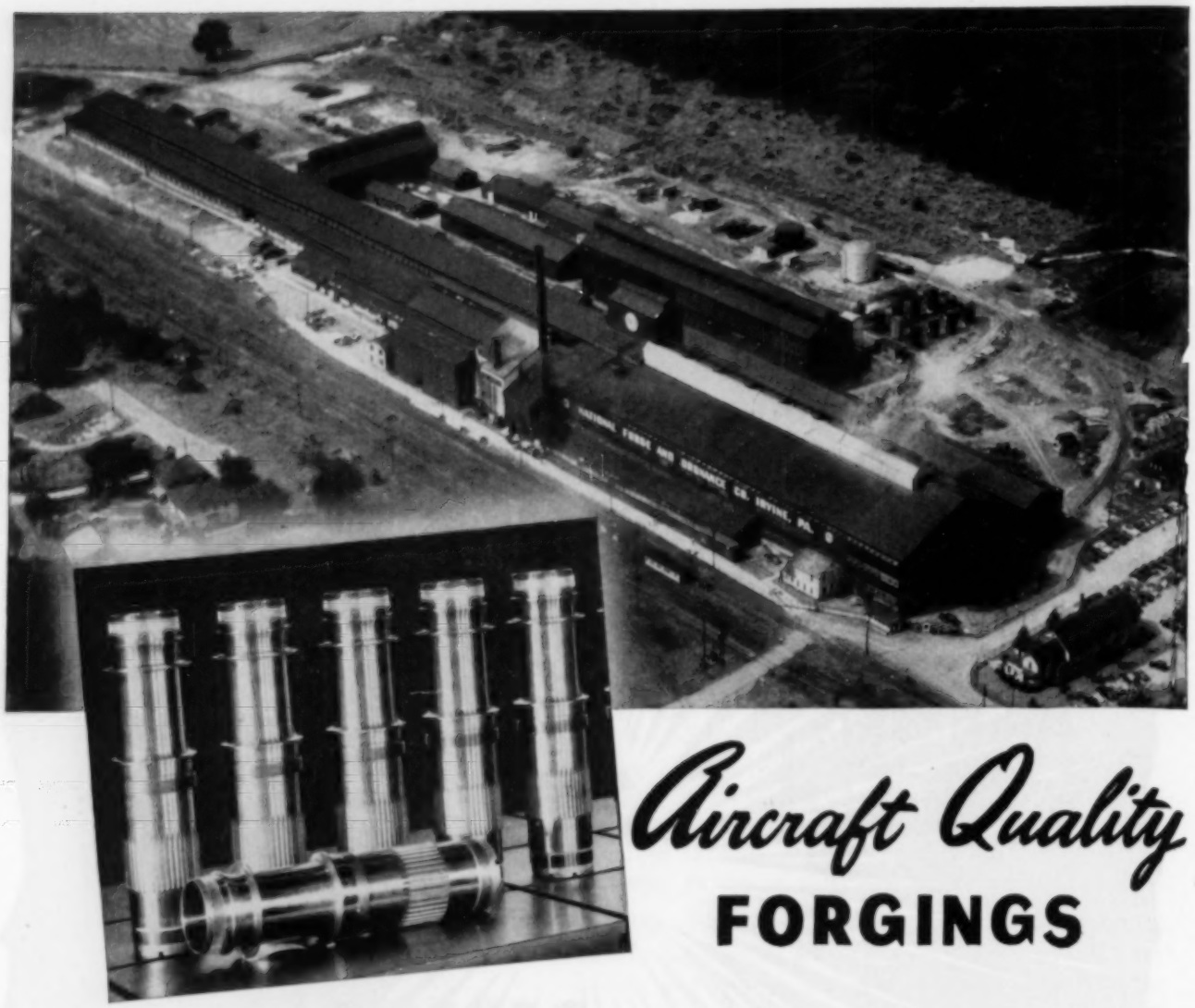

Aircraft Quality FORGINGS

These aircraft jet engine shafts are an example of the quality of forgings and finished machining produced at National Forge.

The steel itself must be made to standards which can only be established by experience and maintained by exceptional ability. National Forge's own electric furnace steel is used, carefully handled to avoid the development of any detrimental condition. Forging, annealing, rough-turning, boring, and heat treating are carried out by people skilled in each process to insure the required quality and ability of the forging to withstand high rotative stresses and temperatures. Frequent checks, such as macro etch discs and magnaflux examination are made to insure this quality through more than eighty operations required to make these shafts.

Finished machining is done to extremely close tolerances. Flanges, splines, threads and bearing surfaces require a variety of special tools and skill on the part of the craftsmen who operate them.

It is unique to find facilities of this kind under one roof. At National Forge there is complete control from the making of the original steel to the final high finish.

National Forge's complete facilities are at **your** disposal. May we have your inquiry on your next forging requirement?

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Irvine, Warren County, Pennsylvania

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HEAT TREATERS ☆ MACHINISTS

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Cycoil is a heavy-duty unit that's designed not to do just a partial job but to deliver practically 100% dust removal efficiency. Over 90% of the total fine dust content of the air is trapped in a Cycoil before reaching the filter section. The remaining dust then passes to the filter cells where it also is removed. Final result—approximately 100% cleaning efficiency plus positive oil circulation for self-cleaning action and large dust-holding capacity.

Anything less than Cycoil's almost perfect efficiency only postpones the day of costly repairs and shutdowns. If you want to settle your dust problems once and for all—write for Cycoil Bulletin 130-D today.

AMERICAN AIR FILTER COMPANY, INC.
402 Central Ave., Louisville 8, Ky.
In Canada: Darling Bros., Ltd., Montreal, P.Q.

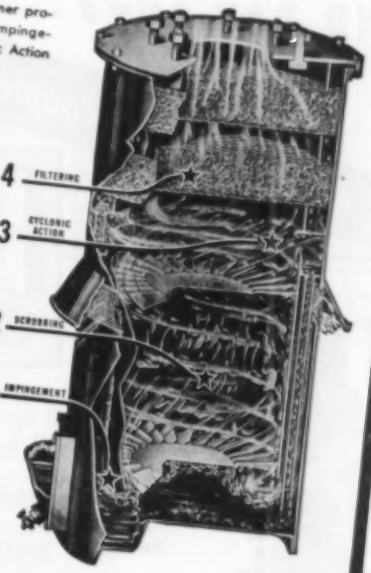
Cycoil Oil Bath Air Cleaner provides 4 way cleaning—Impingement, Scrubbing, Cyclonic Action and Filtering.

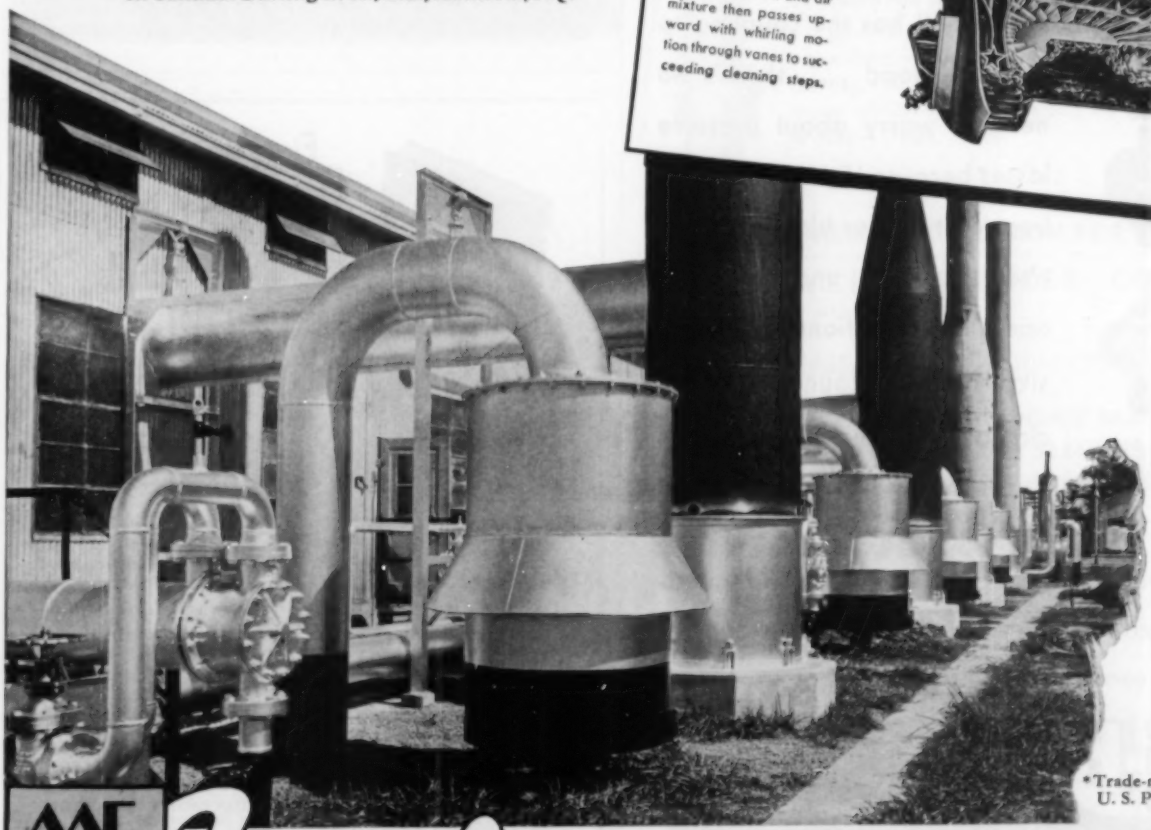
Filtration through Double Cells completes cleaning action eliminating oil mist from air.

Cyclonic action induced by vanes throws oil containing dust outward.

Scrubbing action, thoroughly mixes air and oil, entraining all dust particles.

Impingement of dirty air against oil, deposits the heavier dust particles immediately. Oil and air mixture then passes upward with whirling motion through vanes to succeeding cleaning steps.





*Trade-mark registered U. S. Patent Office.

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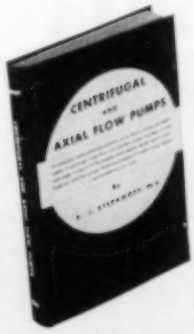

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A study that's *not* just a discussion of elementary theory, but one of the most complete working manuals of theory, design and application ever available to pump engineers in this country.

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Finally, he discusses the problems encountered in operating centrifugal and axial flow pumps and deals with the precautions necessary to insure satisfactory operation.

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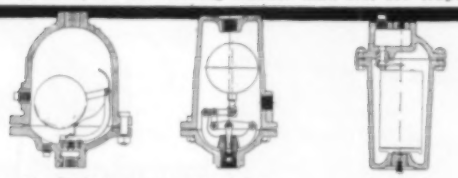
Requires Priming	Yes	No	No
Float collapse or leakage	Impossible	Remote	Remote

*For very heavy oil use nothing smaller than No. 213 trap.



No. 71 Snap Action Air Trap | No. 2 Ball Float Trap | Inverted Bucket Trap

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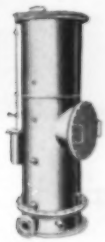

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The lapped surfaces of the valve are "pressure sealed" when the valve is in either the open or closed position. By turning the lubricant screw, lubricant is forced under high pressure through a grooving system that completely encircles the ports as well as the top and bottom of the plug.

The lubricant seals the valve against leakage, and reduces friction between plug and body. This permits easy, quick, full-opening, or tight shut-off with only a quarter turn of the plug.

Number 1700 (illustrated) is a Steel-iron valve, wrench operated, designed for a working pressure of 200 pounds WOG (water, oil, or gas). Valves are available in either screwed or flange types. Screwed type have API line pipe thread lengths. Flanged type (No. 1700F) is faced and drilled to American Standard for 125-pound cast iron flanges unless otherwise specified.

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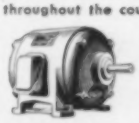
Serviced . . .

by Allis-Chalmers Authorized Dealers, Certified Service Shops and Sales Offices throughout the country.



MOTORS — ½ to 25,000 hp and up. All types.

CONTROL — Manual, magnetic and combination starters; push button stations and components for complete control systems.

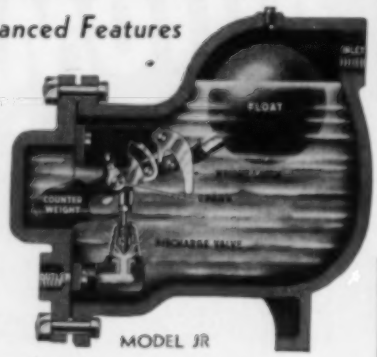
PUMPS — Integral motor and coupled types. Sizes and ratings to 2500 GPM.

ALLIS-CHALMERS

Nicholson Air Traps Assure

POSITIVE DRAINAGE OF AFTERCOOLERS

by 2 Advanced Features



1) Positive Fluid Seal Over Discharge Valve—As a result of this feature Nicholson traps are increasingly specified wherever loss of air is a problem in drainage of aftercoolers, intercoolers, separators, receivers, etc.

2) Extra Large Discharge Capacity—Valve opens wide instantaneously to discharge water, oil and dirt, after which it closes tight—instantaneously.

OTHER TROUBLE-PROOF FEATURES Non-wire drawing, not dependent on buoyancy of float; of stainless steel where it counts, to prevent corrosion; rugged, for unavoidable abuse. 3 types for pressures to 1500 lbs.

Catalog 448 or see Sweet's

W. H. NICHOLSON & CO. 180 OREGON STREET WILKES-BARRE, PA.

Valves ★ Traps ★ Steam Specialties

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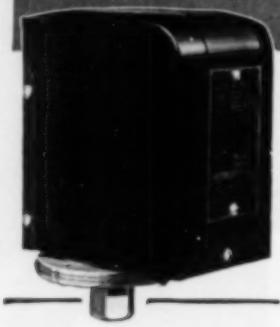
for **AIR COMPRESSORS** *and* **WATER PUMPS**



Class 9013
type ASG

PRESSURE SWITCH

250 lbs. pressure limit
10 to 50 lbs. differential

• A standard controller for motor-driven air compressors and water pumps. Heavy contacts with silver permanently bonded to the heavy bronze backing. Generous electrical ratings. Four ⅞ inch knockouts for ½ inch conduit are provided for convenient wiring.

Modern blue-grey enameled steel cover. Corrosion-resisting inner parts. High-grade impregnated fabric diaphragm. Oil-resisting type also available.

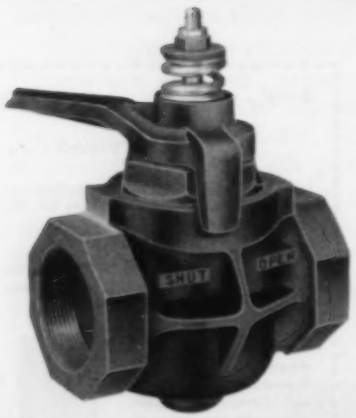
Write for Bulletin • illustrations, specifications of Square D pressure switches and related devices. Address Square D Company, 4041 North Richards Street, Milwaukee 12, Wis.

SQUARE D COMPANY

DETROIT • MILWAUKEE • LOS ANGELES

A GREAT NEW PLUG VALVE FOR COMPRESSED AIR LINES THAT WILL....

$TOP COSTLY VALVE LEAKAGE



COMPRESSED AIR LOSSES through faulty valving are expensive DOLLAR LOSSES.

STOP THEM with DeZurik EASY-OPERATING PLUG VALVES——The Only Valves Built with the AIR-TIGHT RUBBER-FACED PLUG!

DeZurik's Rubber-Faced Plug combines tough, resilient rubber with a rigid metal core. It closes DEAD-SHUT every time, regardless of line pressure or solid-matter intrusions. The plug and seat are eccentrically designed to completely eliminate friction, binding, scoring and lubrication. The plug seals the line with a cushioned, conforming closure, and the hardest, longest use can't stretch or distort it.

Get the details on this air-saving, money-saving line of valves; write for Catalog No. 49.

DeZURIK SHOWER COMPANY RIVERSIDE ROAD SARTELL, MINN

10,000 HOURS WITH KOPPERS PISTON RINGS

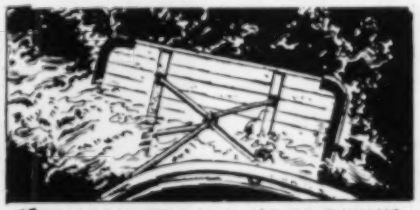
MINUTES ARE DOLLARS

....ON THE FAMOUS FISHING "BANKS"

THE FISHING DRAGGER, "OLYMPIA LA ROSA" LEAVES FOR THE FISHING BANKS AGAIN, AFTER UNLOADING CATCH AT BOSTON WHARF.

ALL HANDS GET READY FOR THE FIRST "DRAG" AS THE "OLYMPIA LA ROSA" DRIVES STEADILY THROUGH THE OCEAN SWELLS.

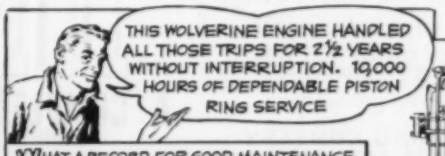
THEY'VE REACHED THE "BANKS"! NOW THE HEAVY BUT INTRICATE WORK BEGINS. CREW MAKES FIRST "SET" AT DAWN WHILE A STIFF NOR' EASTER WHIPS UP THE SEA.



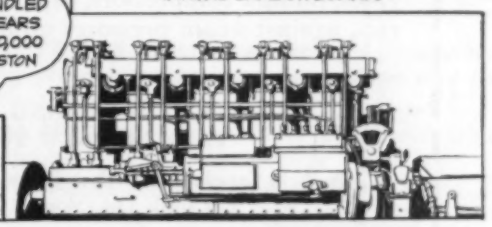
NET IS DRAGGED BY TWO CABLES, RUNNING FROM A FORWARD AND AFT GALLOWS FRAME. THE MOUTH OF THE NET IS HELD OPEN BY PARAVANES OR "BOARDS." HERE THE POWERFUL WOLVERINE DIESEL MUST NOT FAIL OR FALTER...OR THE VALUABLE CATCH WILL SPILL OUT.

THE SAME 195 H.P. WOLVERINE DIESEL POWERS THE DECK WINCHES. MINUTES ARE DOLLARS WHEN THE FISH ARE RUNNING —ANOTHER "SET" IS MADE AS SOON AS THE CATCH IS SAFE ON BOARD.

AS DRAGGING CONTINUES, CREW MEMBERS CLEAN AND ICE THE FISH. ON THE USUAL TRIP, 37 "SETS" ARE MADE....TOTAL TOWING OF CATCHES, THAT AVERAGE 4000 LBS. IS 227 MILES! WHAT A STRAIN ON ANY ENGINE!


THIS WOLVERINE ENGINE HANDLED ALL THOSE TRIPS FOR 2½ YEARS WITHOUT INTERRUPTION. 10,000 HOURS OF DEPENDABLE PISTON RING SERVICE

WHAT A RECORD FOR GOOD MAINTENANCE AND KOPPERS PISTON RINGS WHICH POWER THE "OLYMPIA LA ROSA"! ENGINE STILL IN SERVICE, GIVING RATED POWER — WITH NO INCREASE IN OIL CONSUMPTION.



Two and one-half years and 10,000 hours of tough operation on the fishing banks . . . and still going strong. Engine still gives rated power and no increase in oil consumption!

That's typical of the records Koppers Piston Rings are setting in the tough jobs—on the sea, on the road and on the rails. The reason for these great records can be found in two great Koppers developments in piston rings . . . Porous Chrome* and K-Spun, the miracle metal for piston rings.

Koppers American Hammered Piston Rings are the choice of those who demand better Diesel Engine service at lower costs. Check with Koppers engineers for more details. It will pay you to do it now. Koppers Company, Inc., Piston Ring Dept., Box 626, Baltimore 3, Maryland.

*VAN DER HORST PROCESS

WHAT POROUS CHROME PLATING AND K-SPUN METAL MEAN TO YOU

1. Guaranteed against ring breakage. Tensile strength double ordinary gray iron castings.
2. All rings seat immediately without scuffing and scoring.
3. Ring and cylinder wear greatly reduced.
4. Fifty percent more elasticity—retains shape and tension far longer.
5. Four times greater impact strength means long life in severe service.

KOPPERS

American Hammered

KOPPERS PISTON RINGS

HOW TO SAVE POWER, TIME AND MONEY

Use Garlock 150 Packing on your steam rods!

THOUSANDS of experienced engineers have found that GARLOCK 150 High Pressure Steam Packing performs so *efficiently* that steam waste is eliminated, and *lasts so long* that frequent shut-downs for re-packing are avoided. Those engineers save re-packing time and shut-down expense. They attain peak production and enjoy lower packing cost.

GARLOCK 150 is specially constructed of high grade asbestos and rubber to withstand high pressures and high temperatures. Use it for superior performance on steam engines, pumps, compressors, expansion joints, etc., against steam pressures up to 300 lbs.

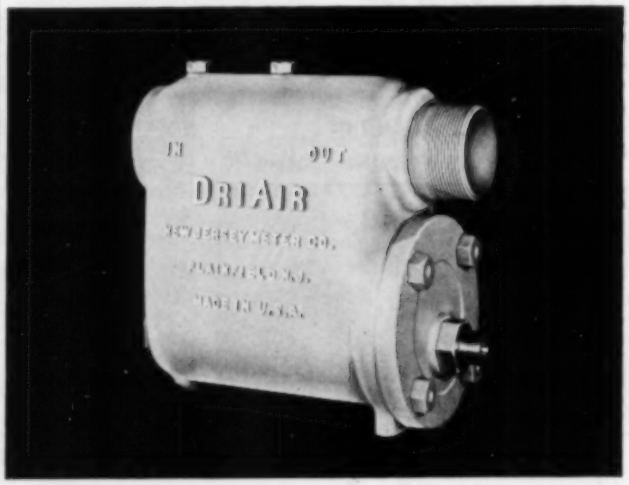
THE GARLOCK PACKING COMPANY
PALMYRA, NEW YORK

In Canada: The Garlock Packing Company of Canada Ltd., Montreal, Que.

GARLOCK 150 Spiral packing
Coil form — GARLOCK 125
Ring Form — GARLOCK 200

GARLOCK 150

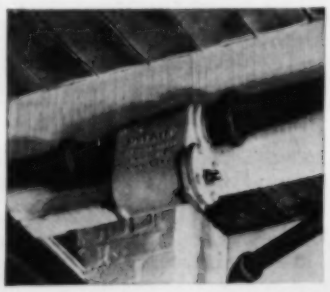
DEPENDABLE PNEUMATIC SERVICE



WHEN EQUIPMENT IS PROTECTED BY

DRIAIR

A COMPLETE SELF-CONTAINED UNIT



DriAir may be installed by suspending it from the piping, without any other support, or may stand on the floor near equipment being protected.

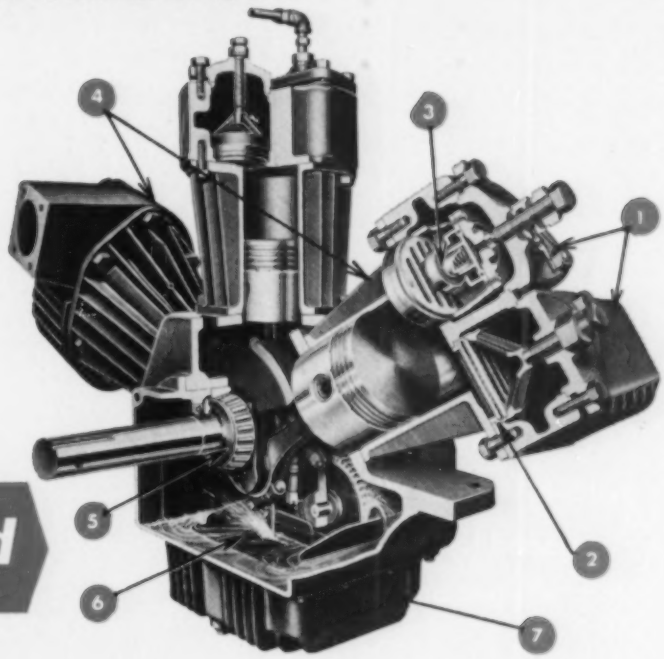
DRIAIR speeds production by separating and automatically ejecting the condensed water and oil from the air. DriAir collects dirt and rust from the air lines and delivers clean dry air to the tools, thus reducing wear and prolonging their life. All internal parts are made of bronze or copper — resistant to corrosion and practically permanent. Copy of Bulletin DA fully describing the operation of DriAir sent on request.

NEW JERSEY METER COMPANY

PLAINFIELD, NEW JERSEY

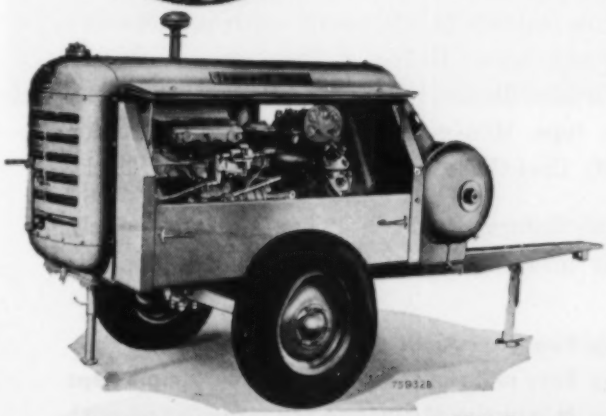
the FINEST COMPRESSOR

you can buy in a PORTABLE



two-stage air-cooled

Ingersoll-Rand MOBIL-AIR AIR POWER



stays new... stays efficient

Fifteen years of continuous development and refinement in design and manufacturing methods have been put into this compressor since Ingersoll-Rand originated the first *Two-Stage Air-Cooled* portable . . . the machine that changed the whole trend in portable compressor design.

This fine, rugged compressor is just one of the many cost-saving features in Ingersoll-Rand's new KA-Series MOBIL-AIR.

1. **DIVIDED HEADS** minimize heat transfer from discharge to intake air . . . cooler valves, longer life, higher efficiency.
2. **CHANNEL VALVES** give high efficiency . . . controlled cushioning prevents valve impact . . . valves stay flat and tight . . . last longer.
3. **ALL-METAL FREE-AIR UNLOADERS** eliminate troublesome diaphragms.
4. **TWIN LOW-PRESSURE CYLINDERS** give better balance . . . better cooling.
5. **TIMKEN TAPERED-ROLLER MAIN BEARINGS** provide anti-friction and permanent alignment.
6. **CONSTANT-LEVEL LUBRICATION** is simple, non-clogging, dependable.
7. **FINNED OIL RESERVOIR** helps maintain low oil temperature.

* **TWO-STAGE COMPRESSION** is 15% more efficient than single-stage . . . lowers discharge temperature, avoids carbonization . . . maintains nearly full capacity at altitude.

** **COMPLETE AIR-COOLING** eliminates all water joints . . . simplifies construction, saves weight . . . compressor cooling system is independent of engine.

331-2

DON'T STOP WITH A GOOD COMPRESSOR!

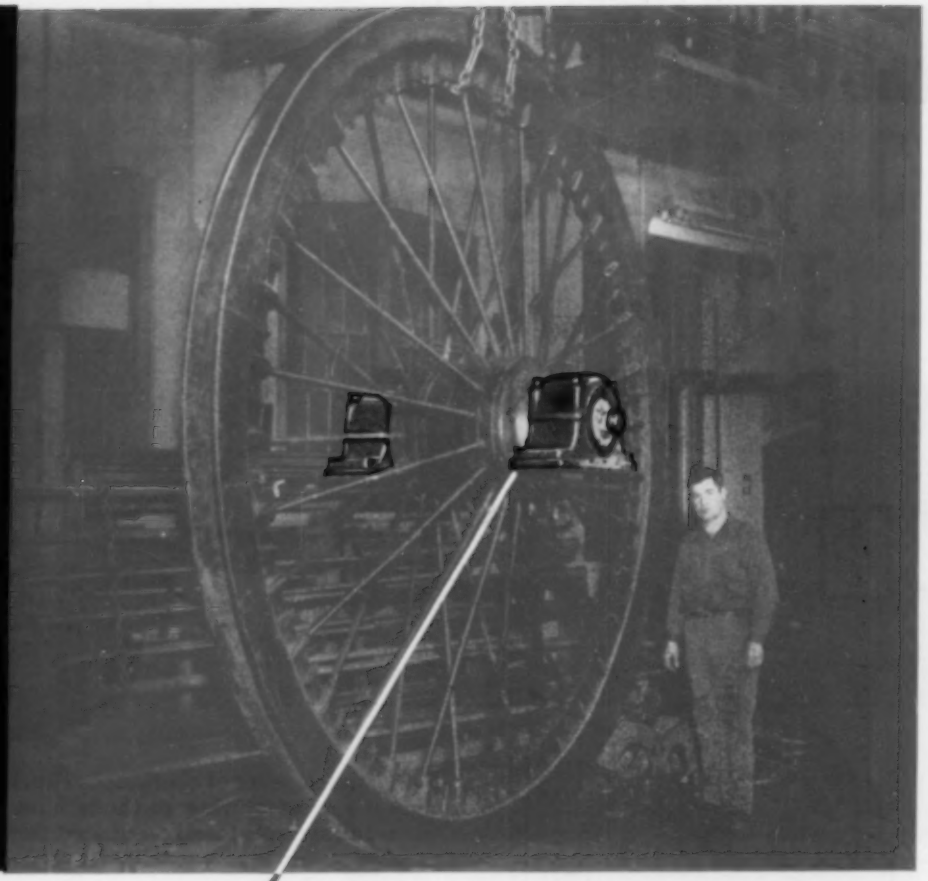
Use the CONTRACTORS' COMBINATION

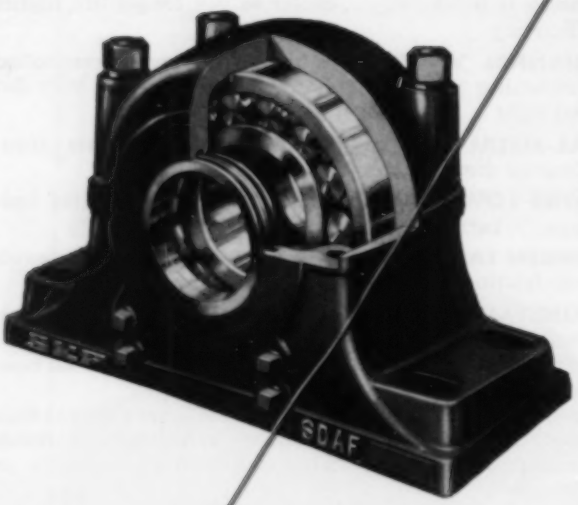
- Everything you need for rock drilling.
- Top quality machines that work as a team.
- Machines designed, built, sold and serviced by men who know rock excavation . . . application "know how".

Ingersoll-Rand

11 BROADWAY, NEW YORK 4, N. Y.

Holmes 12-foot sheave wheel and SKF Pillow Blocks . . . teamed for efficient operation





A sheave wheel takes a lot of punishment, and mine operation depends on its smooth-running efficiency. That's why Robert Holmes & Bros. specified SKF SDAF Pillow Blocks . . . on the five 12-foot diameter, bicycle type, sheave wheel assemblies furnished for Peabody Coal Company's new mine at Pana, Illinois.

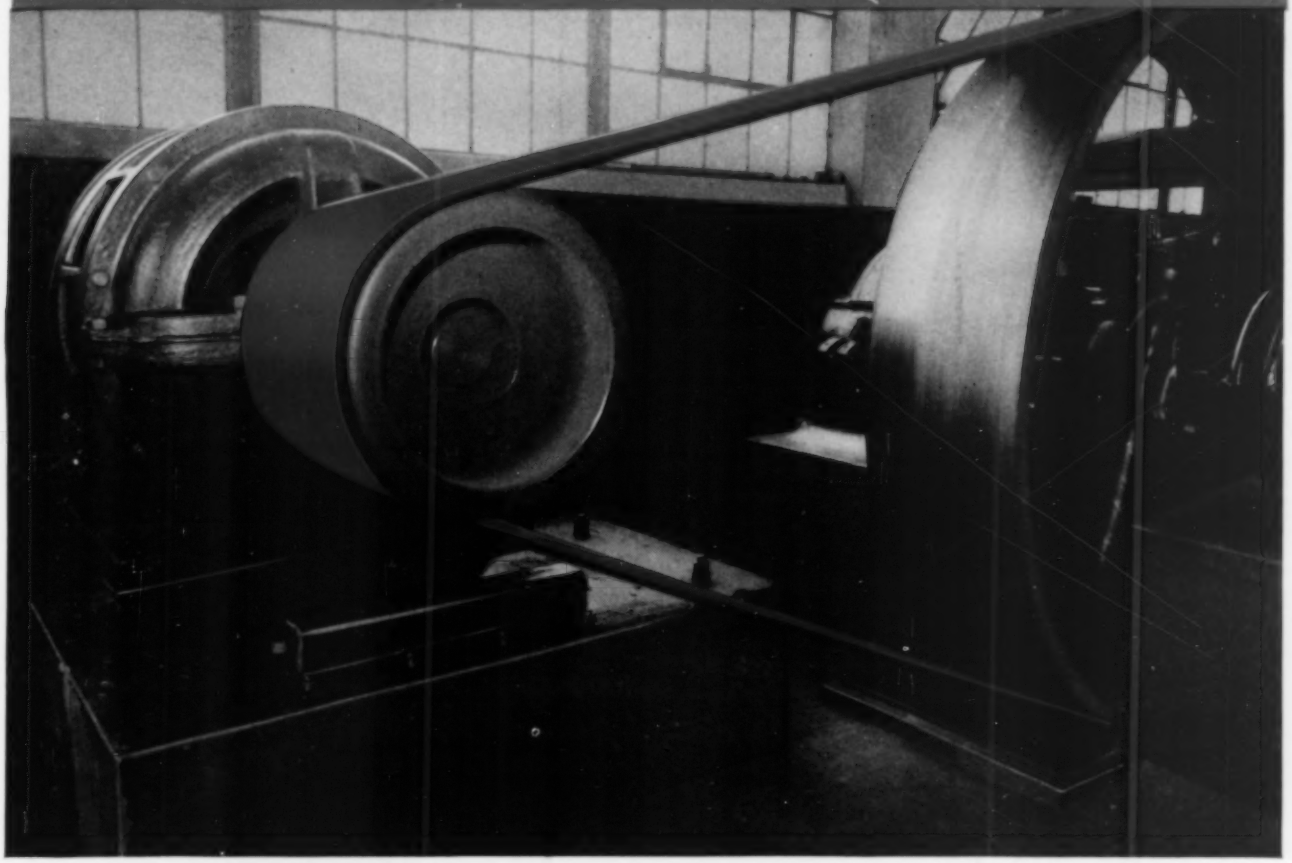
Here are features of SKF Pillow Blocks . . . widely used in mines, mills and factories. Check this list:

- **Rugged—stands up under heavy usage**
- **Easy to Install and Service—a few simple steps**
- **Minimum Maintenance—equipped with SKF's exclusive Triple-Seal rings to keep lubricant *in* . . . dust and water *out*!**
- **Versatile—there's a pillow block for every job!**

Complete engineering service is available. Write us. SKF Industries, Inc., Philadelphia 32, Pa. 6616

PILLOW BLOCKS ENGINEERED BY SKF

DRIVE YOUR COMPRESSOR *more* EFFICIENTLY



WITH RHOADS *Tannate-Rockwood* SHORT CENTER DRIVE

The single strand Tannate leather belt with its high coefficient of friction and correctly maintained tension will deliver your motor power to the compressor with less loss than most drives, and retain its efficiency over a long period. Its resistance to many chemicals, moisture and machine oils assures lower maintenance costs and longer useful life.

The Rockwood pivoted motor base helps maintain an operating efficiency of 97-98% over a wide range of loads, automatically maintaining correct belt tension regardless of load fluctuation. This means smoother and more constant speed and maximum delivered power.

A Rhoads representative will be glad to discuss the advantages of this short center drive as it applies to your special needs.

Send for the 16 page, illustrated booklet describing the Rhoads TANNATE-ROCKWOOD method of driving compressors, fans and pumps . . . IT'S FREE FOR THE ASKING!

PRODUCERS OF FINE LEATHER FOR 247 YEARS

J. E. RHOADS & SONS

35 NORTH SIXTH ST., PHILA. 6, PA.

NEW YORK • CHICAGO • ATLANTA

AIR *without* WEAR

Ingersoll-Rand KA-315 Mobil-Air Compressors equipped with Timken bearings supplying air for rock drilling on an $11,000,000 water supply project in Michigan.

Ingersoll-Rand keeps down wear in their new KA-Series of portable air compressors by mounting the compressor crank shafts on Timken tapered roller bearings. At the same time they assure correct and permanent crank shaft alignment with full protection against radial, thrust and combined loads, simplify lubrication and prolong compressor life. Timken bearings are also used in the wheels of these compressors.

If you are thinking of buying an anti-frictionized compressor of any type — portable or stationary — make sure of getting anti-friction advantages in full; specify Timken tapered roller bearings. The Timken Roller Bearing Company, Canton 6, Ohio.

TIMKEN
TRADE-MARK REG. U. S. PAT. OFF.
TAPERED ROLLER BEARINGS

NOT JUST A BALL NOT JUST A ROLLER THE TIMKEN TAPERED ROLLER BEARING TAKES RADIAL AND THRUST LOADS OR ANY COMBINATION